TREATISES.

In the one of which,

THE NATURE OF BODIES;

In the other,

THE NATURE OF MANS SOUL,

IS LOOKED INTO:

IN WAY OF DISCOVERY

OF THE

IMMORTALITY

OF

REASONABLE SOULS.

Ψυχῆς φύσιν ἱκανῶς λόγου
Καταιδέως ὄντος ἰδεῖν ἄν,
Ἀρά γε μὴ διὰ φύσεως;

Animæ naturam, absque totius naturæ,
Sufficienter cognosci posse, existimas?

Plato in Phædr.

BIBL. CANT. ACAD.

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TO MY SONNE, *KENELME DIGBY.*

SONNE,

THe calamity of this time being such, as hath bereft me of the ordinary means of expressing my affection to you; I have been casting about, to finde some other way of doing that in such sort, as you may receive most profit by it. Therein I soon pitched upon these Considerations; That Parents owe unto their children, not onely material subsistence for their Body, but much more, spiritual contributions to their better part, their Mind. I am much bound to God, that he hath indued you with one, very capable of the best instructions: and wi[illegible] do therefore esteem my self obl[illegible] my [illegible] for [illegible]

it to its moſt advantage. If my aym therein do prove ſucceſſefull, you will with more eaſe digeſt thoſe inconveniences and diſtreſſes which already you have begun to be acquainted with, and that threaten daily worſe unto you. For how can a man ſuffer his heart to be dejected at the privation of any temporal bleſſings, whiles he conſidereth the inanity of them; and that nothing is worthy his ſerious thought, but what may accompany him to his eternal habitation? What needeth he fear the deſolations of war, and the worſt that they can do againſt him, who have his eſtate in their power, when he may be rich with a much nobler treaſure, that none but himſelf can rob him of? Without doubt, he that ſhall ſeriouſly reflect upon the excellency of his own nature, and upon the admirable perfect and happy ſtate he ſhall moſt certainly arrive unto, if he but wean himſelf from thoſe worldly impediments, that here clog his ſoules flight; cannot chooſe but look with a diſdainfull eye, upon the glittering trifles, that weak ſpirits delight themſelves withall. If he deem it not requiſite (as of old, the famous wiſe man did) to throw away thoſe en-

encumbrances, to the end he may the more freely attend unto divine contemplations (for worldly goods, duly used, may be very advantagious both to ones self and to others) yet at the least, he will not repine at Fortunes recalling of what she formerly had but lent him, and but permitted him the use of.

To the end then that you may be armed against the worst that may arrive unto you, in this unhappy state of affairs, in our distressed Countrey; I send you those considerations of the nature and Immortality of humane soules, which of late, have been my chief entertainment. The progress you have already made in the Study of Philosophy, hath (I am perswaded) enabled you to benefit your self, with what I have written upon this subject: on the serious examining of which, if you will imploy but half the time, that I have done in spinning out my thoughts, and weaving them into the piece you see, I doubt not but you will thereby receive so much contentment, as well as profit, that you will not repent you of your pains. Besides that, intellectual entertainments are the purest, and the noblest, and the most proporti-

onate to mans nature, and prove the moſt delightful to him, when they are duly teliſhed. You will preſently agree, that the matter I handle, is the moſt important and the moſt weighty, within the whole extent of humane nature, for a worthy perſon to employ himſelf about. The advantage which Man hath over unreaſonable creatures, is, that what he doth, is by election; and he is himſelf maſter of all his actions; whereas they are impelled by outward cauſes, unto all they do: it is properly ſaid of them, that *aguntur magis quam agunt*: He onely is free; and in all varieties of circumſtances, hath the power to chooſe one, and to reject another. Now, to have this election wiſely made, and becoming a man, requireth that it be ſteered by knowledge. To do any thing well, a man muſt firſt know throughly all that concerneth the action he is about; and chiefly the end of it. And certainly, of all his actions, the government of himſelf, is the moſt important, and neerlieſt concerning him. The end of that government, and of all a mans aims, is by all men agreed to be Beatitude, that is, his being compleatly well, and in a condition of enjoying the moſt

moſt happineſs, that his nature is capable of. For arrival whereunto, it is impoſſible to pitch upon the direct and ſure means, unleſs it be firſt determined, whether the Beatitude we ſpeak of, do belong to this life, or be not to be attained, till we come to the next: or rather, whether or no, there be another life beſides this, to be happy in. For if there remaineth an eternity unto us, after the ſhort revolution of time we ſo ſwiftly run over here on earth; it is clear, that all the happineſs which can be imagined in this fleeting ſtate, is not valuable, in reſpect of the future; nor any thing we do here is conſiderable, otherwiſe than as it conduceth to the making our condition then, better or worſe. Now the way to be ſure of this, is either infallible authority, or evident ſcience. They that rely on the firſt, depend of others: and they onely who know, are abſolutely compleat of themſelves; and have within themſelves, the principles whereby to govern their actions, in what is of higheſt conſequence to them. It is true, every body is not of a ſtrain of wit and judgement, to be of this rank: and who are not, muſt be contented to believe others, and be

ſatisfied with what is taught them. But he that will be of a ſuperiour orb, muſt make this his ſtudy. This is the adequate entertainment of a worthy perſon.

To conceive how high and excellent, this ſcience of governing a man in order to Beatitude in the next world is, we may conſider, how among all Arts that concern this life, the art of a States-man, unto whom belongeth to ſee a Common-wealth well governed, is by much the nobleſt. All other Arts, are but miniſterially to him. He maketh uſe of the Souldier, of the Lawyer, of the Orator, of the Antiquary, of the Phyſician, as beſt conduceth to the end he aimeth at, of making the Common-wealth he governeth, happy and flouriſhing. All other meaner Trades ſerve him in a yet lower degree. Yet after all, he muſt take his meaſures from the Metaphyſician or Divine. For ſince the government of a ſociety of men, aimeth at giving them the beſt being they are capable of; and ſince Mans well-being here in this life, is but inſtrumentally good, as being the means for him to be well in the next life; It is evident, that the States-mans art, is but inſtrumental to that, which

which sheweth, how every particular man must govern his life; to be partaker of a happy eternity. And consequently, if a Statesman hath not this science, he must be subject to a braver man than himself, whose province is to direct all his actions unto this end. We are told, how reverently great *Cæsar* listned to the discourses of learned *Achoreus*, how observant *Alexander* was of his Master *Aristotle*, how secure *Nero* trode, whiles *Seneca* guided his steps, how humble *Constantine* was to Saint *Sylvesters* precepts, how *Charlemain* governed himself in his most important actions, by *Alcuines* advice: In a word, all the great men of Antiquity, as well among the Romans, as among the Grecians, had their Philosophers, and Divines in their kind, belonging to them; from whom they might derive rules of living and doing as they ought upon all occasions, if themselves were not Masters in that superior and all-directing science. He that seeth not by his own light, must in this dangerous Ocean steer by the lantern which another hangeth out to him. If the person he relieth upon, either withholdeth the light from him, or sheweth him a false one, he is presently in the dark,

dark, and cannot fail of losing his way. How great an authority had the Augurs and Priests among the rude Romans, to forbid any publick act, or to break any assembly upon pretence of Religious duties, when they liked not the business that was in agitation? The like may interessed Divines among Christians do, if the Minister of State have not some insight into Divinity. He leadeth a vexatious life, that in his noblest actions is so gored with scruples, that he dareth not make a step, without the authority of another to warrant him.

Yet I do not conclude, that he by whom I design by the character of a brave man, should be a professed or a compleat Metaphysician or Divine, and consummate in every curious circumstance that belongeth to this science; it sufficeth him to know it in bulk; and to have so much Divinity, as in common occurrents, to be able to govern himself; and in special ones, to understand what, and why his Divine perswadeth him to any thing; so that even then, though not without help, yet he governeth himself, and is not blindly governed by another. He that aimeth at being a perfect

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Horſeman, is bound to know in general (beſides the art of riding) the nature and temper of Horſes; and to underſtand the different qualities of Bits, Saddles, and other utenſils of a Horſeman; But the utmoſt exactneſs in theſe particulars, belongeth to Farryers, Sadlers, Smiths, and other Tradeſmen; of all which, the judicious Rider knoweth how to make due uſe, when he hath occaſion, for his principal end; which is, orderly governing his Horſe. In like manner, he whom we deſign by a compleat brave man, muſt know ſolidly the main end of what he is in the World for: and withall, muſt know how to ſerve himſelf when he pleaſeth, and that it is needfull to him, of the Divines high Contemplations, of the Metaphyſicians ſubtile Speculations, of the natural Philoſophers minute Obſervations, of the Mathematicians nice Demonſtrations; and of whatſoever elſe of particular Profeſſions, may conduce to his end; though without making any of them his profeſſed buſineſs.

To lay grounds for ſuch knowledge as this, is the ſcope of my enſuing Diſcourſe. My firſt aim, was to beget it in my ſelf: to which

which end, the digeſting my thoughts into order, and the ſetting them down in writing, was neceſſary: for without ſuch ſtrict examination of them, as the penning them affordeth one means to make, they would hardly have avoyded being disjoynted and roving ones. Now that I have done that, my next aim is that you, unto whom I wiſh as much good as unto my ſelf, may reap as much benefit by the ſtudying it, as I have done by the compoſing it.

My end then being a private one, as (looking no farther than you my Son, and my ſelf) I have not endeavoured to expreſs my conceptions either in the phraſe, or in the language of the Schools. It will ſerve our turn, to comprehend the ſubſtance, without confining our ſelves to any ſcrupulous exactneſs, in what concerneth onely form. And the ſame conſideration hath made me paſs ſlightly over many particulars, in my firſt Treatiſe of the Nature of Bodies; upon which learned and witty men might ſpin out large Volums. For in that part, I aim no farther, than to ſhew what may be effected by corporeal agents. There, poſſibility ſerveth

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my turn, as well as the determinate indiviſible point of truth. I am obliged to that onely in my main great theme; which is the ſoul. In regard of which, the numerous crooked narrow cranies, and the reſtrayned flexuous rivolets of corporea l things, are all contemptible, farther than the knowlege of them ſerveth to the knowledge of the ſoul. And a gallant man, whoſe thoughts fly at the higheſt game, requireth no farther inſight into them, than to ſatisfie himſelf by what way they may be performed; and deemeth it far too mean for him, to dwell upon the ſubtileſt of their myſteries for ſcience ſake.

Beſides this liberty that the ſcope I aym at alloweth me of paſſing very curſorily over ſundry particulars; I find now at my reading all over together, what I have written to deliver it to the Printer, that even in that which I ought to have done to comply with my owne deſigne and expectation, I am fallen very ſhort; ſo that if I had not unwarily too far engaged my ſelf for the preſent publiſhing it, truly I ſhould have kept it by me, till I had once again gone over it. I find the whole piece very confuſedly done;

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the ſtile unequal and unpoliſhed; many particulars (when they are not abſolutely neceſſary to my main drift) too ſlightly touched, and far from being driven home: and in a word, all of it ſeemeth to be rather but a looſe model and rough caſt of what I deſigne to do, than a complete work throughly finiſhed.

But ſince by my over-forward promiſing of this piece to ſeveral friends, that have been very earneſt for it, I have now brought my ſelf to that paſs, that it would ill become me to delay any longer the publiſhing of ſomething upon this ſubject and that obligations of another nature permit me not at the preſent to dwell any longer upon this (beſides that, ſo lazie a braine as mine is, groweth ſoon wearie when it hath ſo entangled a skean as this is to unwind) I now ſend it you as it is, but with a promiſe, that at my firſt leiſure, I will take a ſtrict ſurvey of it; and then in another Edition, will poliſh, correct and add what ſhall appeare needfull to me. If any man ſhall take the Book out of your hand, invited by the Title and ſubject to look into it; I pray you in my behalf repreſent unto him, how diſtant my profeſſion is, and how contrary my education hath

hath been from writing of books. In every Art, the plaineſt that is, there is an Apprentiſhip neceſſary, before it can be expected one ſhould work in it a faſhionable piece. The firſt attempts are alwaies very imperfect aimings; and are ſcarce diſcernable what they are meaned for, unleſs the Maſter guide his Scholars hand. Much more will the ſame happen in ſo difficult and ſpiny an affaire, as the writing upon ſuch a nice and copious ſubject as this is, to one who is ſo wholly ignorant of the lawes of Method as I am.

This free and ingenious acknowledgment on my ſide, will I hope prevail with all ingenuous perſons, who ſhall reade what I have written, to advertiſe me fairely (if they judge it worth their while) of what they diſlike in it: to the end that in another more accurate Edition; I may give them better ſatisfaction. For beſides what failings may be in the matter, I cannot doubt but that even in the expreſſions of it, there muſt often be great obſcurity and ſhortneſs; which I, who have my thoughts filled with the things themſelves, am not aware of. So that, what peradventure may ſeem very full to me, becauſe every imperfect

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touch bringeth into my mind, the entire notion and whole chain of circumſtances belonging to that thing I have ſo often beaten upon, may appear very crude and maimed to a ſtranger, that cannot gueſs what I would be at, otherwiſe than as my direct words do lead him.

One thing more I ſhall wiſh you to deſire of them who happily may peruſe theſe two Treatiſes; as well for their own ſakes, as for mine. And that is, that they will not paſs their cenſure upon any particular piece, or broken parcel of either of them, taken by it ſelf. Let them draw the entire thred through their fingers, and let them examine the conſequentneſs of the whole body of the doctrine I deliver; and let them compare it by a like ſurvey with what is ordinarily taught in the Schools: and if they finde in theirs, many bracks and ſhort ends which cannot be ſpun into an even piece, and in mine, a faire coherence throughout; I ſhall promiſe my ſelfe a favourable doom from them, and that they will have an acquieſcence in themſelves to what I have here preſented them with; whereas, if they but ravel it over looſely, & pitch upon diſputing

ting against particular concluſions, that at the firſt encounter of them ſingle, may ſeem harſh unto them, (which is the ordinary courſe of flaſhy wits, who cannot ſadom the whole extent of a large diſcourſe) it is impoſſible but that they ſhould be very much unſatisfied of me; and go away with a perſwaſion, that ſome ſuch truths as upon the whole matter are moſt evident (one ſtone in the arch ſupporting another, and the whole) are meer Chymeras and wild paradoxes.

But (Son) it is time my Book ſhould ſpeak it ſelf, rather than I ſpeak any longer of it here. Read it carefully over, and let me ſee by the effects of your governing your ſelf, that you make ſuch right uſe of it, as I may be comforted in having choſen you to bequeath it unto. God in heaven bleſs you. *Paris* the laſt of *Auguſt*, 1644.

Your Loving Father,

KENELME DIGBY.

THE PREFACE.

This writing was designed to have seen the light under the name of one Treaise. But after it was drawn in paper; as I cast a view over it, I found the Prooemial part (which is that which treateth of bodies) so ample in respect of the other (which was the end of it, and for whose sake I medled with it) that I readily apprehend my Reader would think I had gone much astray from my Text, when proposing to speak of the Immortality of Mans Soul, three parts of four of the whole Discourse, should not so much as in one word mention that Soul, whose Nature and properties I aymed at the discovery of. To avoid this incongruity, occasioned me to change the name and unity of the work, and to make the survay of bodies, a body by it self: though subordinate to the Treatise of the Soule. Which notwithstanding it be less in bulk than the other, yet I dare promise my Reader that if he bestow the pains requisite to perfect himself in it, he will find as much time well spent in the due reading of it, as in the reading of the former Treatise, though far more large.

But I discern an objection obvious to be made, or rather a Question; Why I should spend so much time in the consideration of Bodies, wherein none that hath formerly written of this subject, hath in any measure done the like?

I might answer that they had, upon other occasions, first written of the nature of Bodies: as I may instance in Aristotle;

ſtotle; and ſundry others, who either have themſelves profeſſedly treated the Science of Bodies, or have ſuppoſed that part ſufficiently performed by other pens. But truly, I was by an unavoidable neceſſity hereunto obliged: which is, a current of doctrine that at this day, much raigneth in the Chriſtian Schools, where bodies and their operations, are explicated after the manner of ſpiritual things. For we having very ſlender knowledge of ſpiritual ſubſtances, can reach no farther into their nature, than to know that they have certain powers, or qualities; but can ſeldom penetrate ſo deep, as to deſcend to the particulars of ſuch Qualities, or Powers. Now our modern Philoſophers have introduced ſuch a courſe of learning into the Schools, that unto all queſtions concerning the proper nature of Bodies, and their operations, it is held ſufficient to anſwer, they have a quality, or a power to do ſuch a thing. And afterwards they diſpute whether this Quality or Power, be an Entity diſtinct from its ſubject, or no; and how it is ſeparable, or unſeparable from it, and the like. Conformable to this, who will look into the books, which are in vogue in theſe Schools, ſhall find ſuch anſwers and ſuch controverſies every where, and few others. As, of the ſenſible qualities: ask what it is to be white or red, what to be ſweet or ſour, what to be odoriferous or ſtinking, what to be cold or hot? And you are preſently paid with, that it is a ſenſible quality, which hath the power to make a wall white or red, to make a meat agreeable, or diſagreeable to the taſte, to make a grateful or ungrateful ſmell to the noſe, &c. Likewiſe they make the ſame queſtions and reſolutions, of Gravity and Levity: as whether they be qualities, that is, entities diſtinct from their ſubject: and whether they be active or paſſive; which when they have diſputed ſlightly, and in common, with logical arguments; they reſt there, without any farther ſearching into the phyſical cauſes or effects of them. The like you ſhall find of all ſtrange effects

of them. The Loadstone and Electrical bodies are produced for miraculous, and not understandable things; and in which, it must be acknowledged, that they work by hidden qualities, that mans wit cannot reach unto. And ascending to living bodies, they give it for a Maxim: that life is the action of the same Entity upon it self: that Sense is likewise a work of an intrinsecal power, in the part we call Sense, upon it self. Which, our predecessors held the greatest absurdities that could be spoken in Philosophy. Even some Physicians, that take upon them to teach the curing of our bodies, do often pay us with such terms: among them, you have long discourses of a retentive, of an expulsive, of a purging, of a consolidating faculty: and so of every thing that either passeth in our body, or is applied for remedy. And the meaner sort of Physicians know no more, but that such faculties are; though indeed they that are truly Physicians, know also in what they consist; without which knowledge it is much to be feared, Physicians will do more harm than good.

But to return to our subject: this course of doctrine in the Schools, hath forced me to a great deal of pains in seeking to discover the nature of all such actions (or of the main part of them) as were famed for incomprehensible: for what hope could I have, out of the actions of the soul to convince the nature of it to be incorporeal; if I could give no other account of bodies operations, than that they were performed by qualities occult, specifical, or incomprehensible? Would not my adversary presently answer, that any operation, out of which I should press the souls being spiritual, was performed by a corporeal occult quality? and that as he must acknowledg it to be incomprehensible, so must I likewise acknowledge other qualities of bodies, to be as incomprehensible: & therefore could not with reason press him, to shew how a body was able to do such an operation; as I should infer must of necessity proceed

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from a spirit, since that neither could I give account how the loadstone drew iron, or looked to the North; how a stone, and other heavy things were carried downwards; how sight or fantasie was made; how digestion or purging were effected; and many other such questions, which are so slightly resolved in the Schools.

Besides this reason, the very desire of knowledge in my self, and a willingness to be available unto others (at the least so far as to set them on seeking for it, without having a prejudice of impossibility in attaining it) was unto me a sufficient motive, to inlarge my discourse to the bulk it is risen unto. For what a misery is it, that the flower and best wits of Christendom, which flock to the Universities, under pretence and upon hope of gaining knowledge, should be there deluded; and after many years of toil and expence, be sent home again, with nothing acquired more than a faculty, and readiness to talk like Parrats of many things; but not to understand so much as any one; and withall with a perswasion that in truth nothing can be known? For setting knowledge aside, what can it avail a man to be able to talk of any thing? What are those wranglings, where the discovery of truth is neither sought, nor hoped for, but meerly vanity and ostentation? Doth not all tend, to make him seem and appear that which indeed he is not? Nor let any body take it ill at my hands, that I speak thus of the modern Schools: for indeed it is rather themselves than I that say it. Excepting Mathematicks, let all the other Schools pronounce their own minds, and say ingenuously, whether they themselves believe they have so much as any one demonstration, from the beginning to the ending of the whole course of their learning. And if all, or the most part, will agree that any one position is demonstrated perfectly, and as it ought to be, and as thousands of conclusions are demonstrated in Mathematicks; I am ready to undergo

the blame of having calumniated them, and will as readily make them amends. But if they neither will nor can; then their own verdict cleareth me: and it is not so much I, as they, that make this profession of the shallowness of their doctrine. And to this purpose I have often heard the lamentations of divers, as great wits as any that converse in the schooles, complaining of this defect. But in so great an evidence of the effect, proofs are superfluous.

Wherefore I will leave this subject, to declare what I have here designed, and gone about, towards the remedy of this inconvenience. Which is that whereas in the Schools, there is a loose method, or rather none; but that it is lawfull, by the liberty of a Commentator, to handle any question, in any place (which is the cause of the slightness of their doctrine, and can never be the way to any science or certitude) I have taken my beginnings from the commonest things that are in nature: namely, from the notions of Quantity, & its first differences which are the most simple, and radical notions that are; and in which all the rest are to be grounded. From them I endeavour by immediate composition of them, and derivation from them, to bring down my discourse to the Elements, which are the primary and most simple bodies in nature. From these, I proceed to compounded bodies; first, to those that are called mixed; and then, to living bodies: declaring in common the proprieties & operations that belong unto them. And by occasion as I pass along, I light here and there on those operations, which seem most admirable in nature; to shew how they are performed; or at the least, how they may be performed: that though I miss in particular of the industry of nature, yet I may nevertheless hit my intent; which is, to trace out a way, how these and such like operations may be effected by an exact disposition, and ordering (though intricate) of quantitative and corporeal parts. And to them, that they oblige us not to

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recur unto hidden and unexplicable qualities. And if I have declared so many of these, as may beget a probable perswasion in my reader, that the rest which I have not touched, may likewise be displayed, and shewed to spring out of the same grounds of curious and constant searchers into nature, will make their task to penetrate into them; I have therein obtained my desire and intent; which is onely, to shew from what principles, all kinds of corporeal operations do proceed; and what kind of operations all these must be, which may issue out of this principles: to the end, that I may from thence, make a step to raise my discourse to the contemplation of the soul; and shew, that her operations are such, as cannot proceed from those principles; which being adequate and common to all bodies, we may rest assured, that what cannot issue from them, cannot have a body for its source.

I will therefore end this preface, with entreating my Reacer to consider, that in a discourse proceeding in such order as I have declared, he must not expect to understand, and be satisfied, with what is said in any middle or latter part, unless he first have read and understood what goeth before. Wherefore, if he cannot resolve with himself, to take it along orderly as it lyeth from the beginning, he shall do himself (as well as me) right, not to meddle at all with this book. But if he will employ any time upon it, to receive advantage by it, he must be content to take the pains to understand throughly every particular as it is set down. And if his memory will not serve him to carry every one along with him, yet at the last, let him be sure to remember the place where it is handled: and upon occasion, return a look back upon it, when it may stand him in stead. If he thinketh this diligence too burthensome, let him consider that the writing hereof hath cost the Authour much more pains: who as he will esteem them exceedingly well employed, if they may contribute ought to the content or advan-

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tage of any free and ingenuous mind; so if any others shall expresse a neglect of what he hath with so much labour hewed out of the hard rock of Nature; or shall discourteously cavil at the nutriment he so freely imparteth unto them; all the resentment he shall make thereof, will be to desire the first, to consider, that their slight esteem of his work, obligeth them to entertain their thoughts with some more noble and more profitable subject, and better treated, than this is: and the later sort, to justifie their dislike of his doctrine, by delivering a fairer and more compleat body of Philosophy, of their own. Which if herenpon they do, his being the occasion of the ones bettering themselves, and of the others bettering the world, will be the best success he can wish his Book.

A Table ſhewing what is contained in the ſeveral Chapters and Sections in this *Treatiſe* concerning *Bodies*.

The figures after the Chapters, are the Sections belonging to every Chapter: which Sections the Reader ſhall finde in every Chapter by their figures in the Margin.

CHAP. I.

THe Preface. A preamble to the whole diſcourſe; concerning notions in general.

1. *Quantity is the firſt, and moſt obvious affection of a body.*
2. *Words do not expreſs things as they are in themſelves, but onely as they are painted in the minds of men.*
3. *The firſt error that may ariſe from hence; which is a multiplying of things, where no ſuch multiplication is really found.*
4. *A ſecond error is the conceiving of many diſtinct things as really one thing.*
5. *Great care to be taken to avoid the errours which may ariſe from our manner of underſtanding things.*
6. *Two ſorts of words to expreſs our notions; the one common to all men, the other proper to ſcholars.*
7. *Great errors ariſe by wreſting words from their common meaning, to expreſs a more particular or ſtudied notion.*

CHAP. II.
Of Quantity.

1. *We muſt know the vulgar and common notion of Quantity, that we may underſtand the nature of it.*
2. *Extenſion or diviſibility is the common notion of Quantity.*
3. *Parts of Quantity are not actually in their whole.*
4. *If parts were actually in their whole, Quantity would be compoſed of indiviſibles.*
5. *Quantity cannot be compoſed of indiviſibles.*
6. *An objection to prove that parts are actually in Quantity; with a declaration of the miſtake from whence it proceedeth.*
7. *The ſolution of the former objection: and that ſenſe cannot diſcern whether one part be diſtinguiſhed from one another; or no.*
8. *An enumeration of the ſeveral*

species of Quantity, which confirmeth that the essence of it is divisibility.

CHAP. III.

Of Rarity and Density.

1. *What is meant by Rarity and Density.*
2. *It is evident that some bodies are rare and others dense; though obscure, how they are such.*
3. *A brief enumeration of the several properties belonging to rare and dense bodies.*
4. *The opinion of those philosophers declared, who put rarity to consist in an actual division of a into little parts.*
5. *The former opinion rejected, and the ground of their error discovered.*
6. *The opinion of those philosophers related, who put rarity to consist in the mixtion of vacuity among bodies.*
7. *The opinion of vacuities refuted.*
8. *Rarity and Density consist in the several proportions which Quantity hath to its substance.*
9. *All must admit in Physical bodies, a Metaphysical composition.*

CHAP. IV.

Of the four first qualities: and of the four Elements.

1. *The notions of density and rarity have a latitude capable of infinite variety.*
2. *How moistness and driness are begotten in dense bodies.*
3. *How moistness and driness are begotten in rare bodies.*
4. *Heat is a property of rare bodies, and cold of dense ones.*
5. *Of the two dense bodies, the less dense is more cold: but of the two rare ones, the less rare is less hot.*
6. *The extreme dense body is more drie, than the extreme rare one.*
7. *There are but four simple bodies: and these are rightly named Elements.*
8. *The Author doth not determine whether every element doth comprehend under its name one onely lowest species, or many: nor whether any of them be found pure.*

CHAP. V.

Of the operations of the Elements in general. And of their Activities compared with one another.

1. *The first operation of the Elements is division, out of which result-*

resulteth local motion.
2. What place is both notionally, and really.
3. Local motion is that division, whereby a body changeth its place.
4. The nature of quantity of it self is sufficient to unite a body to its place.
5. All operations amongst bodies are either local motion, or such as follow out of local motion.
6. Earth compared to water in activity.
7. The manner whereby fire getteth into fewel, proveth that it exceedeth earth in activity.
8. The same is proved by the manner, whereby fire cometh out of fewel and worketh upon other bodies.

CHAP. VI.

Of Light, what it is.

1. In what sense the Author rejecteth qualities.
2. In what sense the Author doth admit of qualities.
3. Five arguments proposed to prove that light is not a body.
4. The two first reasons to prove light to be a body are, the resemblance it hath with fire, and because if it were a quality, it would alwaies produce an equal to it self.
5. The third reason, because if we imagine to our selves the substance of fire to be rarified, it will have the same appearance which light hath.
6. The fourth reason, from the manner of the generation and corruption of light, which agreeth with fire.
7. The fifth reason, because such properties belong to light as agree onely unto bodies.

CHAP. VII.

Two objections answered against light being fire, a more ample proof of its being such.

1. That all light is hot and apt to heat.
2. The reason why our bodies for the most part do not feel the heat of pure light.
3. The experience of burning glasses, and of soultry gloomy weather, prove light to be fire.
4. Philosophers ought not to judge of things by the rules of vulgar people.
5. The different names of light and fire, proceed from different notions of the same substance.
6. The reason why many times fire and heat are deprived of light.
7. What becommeth of the body of light when it dieth.

8. *An experiment of ſome who pretend that light may be precipitated into powder.*
9. *The Authors opinion concerning lamps, pretended to have been found in tombs, with inconſumptible lights.*

CHAP. VIII.

An anſwer to three other objections formerly propoſed againſt light being a ſubſtance.

1. *Light is not really in every part of the room it enlighteneth, nor fils entirely any ſenſible part of it, though it ſeem to us to do ſo.*
2. *The leaſt ſenſible point of a diaphanous body, hath room ſufficient to contain both air and light, together with a multitude of beams iſſuing from ſeveral lights without penetrating one another.*
3. *That light doth not enlighten any room in an inſtant, and that the great celerity of its motion doth make it inperceptible to our ſenſes.*
4. *The reaſon why the motion of light, is not diſcerned coming towards us, and that there is ſome real tardity in it.*
5. *The planets are not certainly ever in that place where they appear to be.*
6. *The reaſon why light being a body, doth not by its motion ſhatter other bodies into pieces.*
7. *The reaſon why the body of light is never perceived to be fanned by the wind.*
8. *The reaſons for, and againſt lights being a body, compared together.*
9. *A ſummary repetition of the reaſons which prove that light is fire.*

CHAP. IX.

Of local motion in common.

1. *No local motion can be performed without ſucceſſion.*
2. *Time is the common meaſure of all ſucceſſion.*
3. *What velocity is, and that it cannot be infinite.*
4. *No force ſo little, that is not able to move the greateſt weight imaginable.*
5. *The chief principle of Mechanicks, deduced out of the former diſcourſe.*
6. *No moveable can paſs from reſt to any determinate degree of velocity, or from a leſſer degree to a greater, without paſſing through all the intermediate degrees which are below the obtained degree.*
7. *The conditions which help to motion, in the moveable are three; in the medium one.*
8. *No body hath any intrinſecal virtue to move it ſelf towards any determine part of the univerſe.*

9. *The*

9. *The encreaſe of motion is alwayes made in the proportion of the odd numbers.*
10. *No motion can encreaſe for ever, without comming to a period.*
11. *Certain problemes reſolved concerning the proportion of ſome moving Agents compared to their effects.*
12. *When a moveable cometh to reſt, the motion doth decreaſe according to the rules of encreaſe.*

CHAP. X.

Of gravity and Levity; and of Local motion, commonly termed Natural.

1. *Thoſe motions are called natural, which have conſtant cauſes; and thoſe violent which are contrary to them.*
2. *The firſt and moſt general operation of the ſun, is the making and raiſing of atoms.*
3. *The light rebounding from the earth with atoms, cauſeth two ſtreams in the air; the one aſcending, the other deſcending; and both of them in a perpendicular line.*
4. *A denſe body placed in the air between the aſcending and deſcending ſtream, muſt needs deſcend.*
5. *A more particular explication of all the former doctrine touching gravity.*
6. *Gravity and levity do not ſignifie an intrinſecal inclination to ſuch a motion in the bodies themſelves which are termed heavy and light.*
7. *The more denſe a body is, the more ſwiftly it deſcendeth.*
8. *The velocity of bodies deſcending doth not encreaſe in proportion to the difference that may be between their ſeveral denſities.*
9. *More or leſs gravity doth produce a ſwifter or a ſlower deſcending of a heavy body.* Ariſtotles *argument to diſprove motion* in vacuo, *is made good.*
10. *The reaſon why at the inferior quartor of a circle, a body doth deſcend faſter by the arch of that quarter, than by the cord of it.*

CPAP. XI.

An anſwer to objections againſt the cauſes of natural motion avowed in the former chapter and a refutation of the contrary opinion.

1. *The firſt objection anſwered; why a hollow body deſcendeth ſlower than a ſolid one.*
2. *The ſecond objection anſwered, and the reaſons ſhown why atoms do continually over-*

take the descending dense body.
3. A curious question left undecided.
4. The fourth objection answered, why the descent of the same heavy bodies is equall, in so great inequality of the atomes which cause it.
5. The reason why the shelter of a thick body doth not hinder the descent of that which is under it.
6. The reason why some bodies sink, others swim.
7. The fifth objection answered concerning the descending of heavy bodies in streams.
8. The sixth objection answered; and that all heavy elements do weigh in their own spheres.
9. The seventh objection answered, and the reason why we do not feel the course of the air, and atoms that beat continually upon us.
10. How in the same body gravity may be greater than density, and density than gravity; though they be the same thing.
11. The opinion of gravities being an intrinsecal inclination of a body to the center, refuted by reason.
12. The same opinion refuted by several experiences.

CHAP. XII.
Of violent Motion.

1. The state of the question touching the cause of violent motion.
2. That the medium is the onely cause, which continueth violent motion.
3. A farther explication of the former doctrine.
4. That the air hath strength enough to continue violent motion in a moveable.
5. An answer to the first objection; that air is not apt to conserve motion: and how violent motion cometh to cease.
6. An answer to the second objection, that the air hath no power over heavy bodies.
7. An answer to the third objection, that an arrow should fly faster broad wayes than long wayes.

CHAP. XIII.
Of three sorts of violent motion Reflexion, Undulation and Refraction.

1. That reflexion is a kind of violent motion.
2. Reflexion is made at equal angles.
3. The causes and properties of undulation.

4. *Refraction at the entrance into the reflectent body is towards the perpendicular; at the going out, it is from it; when the second superficies is parallel to the first.*
5. *A refutation of* Monsieur des Cartes *his explication of refraction.*
6. *An answer to the Arguments brought in favour of* Monsieur des Cartes *his opinion.*
7. *The true cause of refraction of light both at its entrance, and at its going out from the reflecting body.*
8. *A general rule to know the nature of reflection and refractions in all sorts of surfaces.*
9. *A body of greater parts, and greater pores, maketh a greater refraction than one of lesser parts and lesser pores.*
10. *A confirmation of the former doctrine, out of the nature of bodies that refract light.*

CHAP. XIV.

Of the composition, qualities & generation of mixed bodies.

1. *The connexion of this chapter with the rest, and the Authors intent in it.*
2. *That there is a least size of bodies; and that this least size is found in fire.*
3. *The first conjunction of parts is in bodies of least size; and it is made by the force of Quantity.*
4. *The second sort of conjunction, is compactedness in simple Elements, and it proceedeth from density.*
5. *The third conjunction is of parts of different Elements, and it proceedeth from quantity and density together.*
6. *The reason why liquid bodies do easily joyn together; and dry ones difficultly.*
7. *That no two hard bodies can touch one another immediately.*
8. *How mixed bodies are framed in general.*
9. *The cause of the several degrees of solidity in mixed bodies.*
10. *The rule whereunto are reduced all the several combinations of Elements in compounding of mixed bodies.*
11. *Earth and water are the basis of all permanent mixed bodies.*
12. *What kind of bodies those are where water is the basis, and earth the predominant Element over the other two.*
13. *Of those bodies, where water being the basis, air is the predominant element.*
14. *What kind of bodies result, where water is the basis, and fire the predominant Element.*
15. *Of those bodies, where water is*

is in exceſs, it alone being both the baſis, and the predominant Element.

16. Of thoſe bodies, where earth alone is the baſis, and alſo the predominant in exceſs over the other three Elements.

17. Of thoſe bodies where earth is the baſis, & water the predominant element over the other two.

18. Of thoſe bodies, where earth being the baſis, air is the predominant.

19. Of thoſe bodies, where earth being the baſis, fire is the predominant.

20. All the ſecond qualities of mixed bodies, ariſe from ſeveral combinations of the firſt qualities, and are at laſt reſolved into ſeveral degrees of rarity and denſity.

21. That in the planets and ſtars there is a like variety of mixed bodies cauſed by light, as here upon earth.

22. In what manner the Elements do work upon one another, in the compoſition of mixed bodies: and in particular, fire, which is the moſt active.

23. A parsicular declaration touching the generation of metals.

CHAP. XV.

Of the diſſolution of mixed bodies.

1. Why ſome bodies are brittle, and others tough, are apt to withſtand outward violence the firſt inſtrument to diſſolve mixed bodies.

2. How outward violence doth work upon the moſt compacted bodies.

3. The ſeveral effects of fire, the ſecond and cheifeſt inſtrument to diſſolve all compounded bodies.

4. The reaſon why ſome bodies are not diſſolved by fire.

5. The reaſon why fire melteth gold, but cannot conſume it.

6. Why lead is eaſily conſumed and calcined by fire.

7. Why and how ſome bodies are divided by fire into ſpirits, waters, oyls, ſalts, and earth. And what thoſe parts are.

8. How water, the third inſtrument to diſſolve bodies, diſſolveth calx into ſalt; and ſo into terra damnata.

9. How water mingled with ſalt, becometh a moſt powerful Agent to diſſolve other bodies.

10. How putrifaction is cauſed.

CHAP. XVI.

An explication of certain Maximes touching the operations & qualities of bodies: and whether the Elements be found pure in any part of the world.

1. What is the ſphere of activity in corporeal agents.

2. The

2. *The reason why no body can work in distance.*
3. *An objection answered against the manner of explicating the former axiom.*
4. *Of reaction: and first in pure local motion, that each Agent must suffer in acting and act in suffering.*
5. *The former doctrine applyed to other local motions designed by particular names. And that* Suisseths *argument is of no force against this way of* Doctrine.
6. *Why some notions do admit of intension and remission; and others do not.*
7. *That in every part of our habitable world; all the four elements are found pure in small atoms; but not in any great bulk.*

CHAP. XVII.

Of rarefaction and condensation the two first motions of particular bodies.

1. *The Authours intent in this and the following chapters.*
2. *That bodies may be rarified, both by outward heat; and how this is performed.*
3. *Of the great effects of Rarefaction.*
4. *The first manner of condensation by heat.*
5. *The second manner of condensation by cold.*
6. *That yce is not water rarified but condensed.*
7. *How wind, snow, and hail are made; and wind by rain allaid.*
8. *How parts of the same or divers bodies, are joyned more strongly together by condensation.*
9. *Vacuities cannot be the reason why water impregnated to the full with one kind of salt, will notwithstanding receive more of another.*
10. *The true reason of the former effect.*
11. *The reason why bodies of the same nature do joyn more easily together than others.*

CHAP. XVIII.

Of another motion belonging to particular bodies, called Attraction; and of certain operations termed magical.

1. *What Attraction is, and from whence it proceedeth.*
2. *The true sense of the Maxim, that* Nature abhorreth from vacuity.
3. *The true reason of attraction.*
4. *Water may be brought by the force of attraction to what height soever.*
5. *The Doctrine touching the attraction of water in Syphons.*
6. *That the Syphon doth not prove water to weigh in its own orb.*
7. *Concerning*

7. Concerning attraction caused by fire.
8. Concerning attraction made by virtue of hot bodies, amulets, &c.
9. The natural reason given for divers operations, esteemed by some to be magical.

CHAP. XIX.

Of three other motions belonging to particular bodies, Filtration, Restitution, and Electrical attraction.

1. What is Filtration; and how it it effected.
2. What causeth the water in filtration to ascend.
3. Why the filter will not drop unless the label hang lower than the water.
4. Of the motion of Restitution: and why some bodies stand bent, others not.
5. Why some bodies return onely in part to their natural figure; others entirely.
6. Concerning the nature of those bodies which do shrink and stretch.
7. How great and wonderfull effects, proceed from small, plain, and simple principles.
8. Concerning Electrical attraction, and the causes of it.
9. Cabeus his opinion refuted concerning the cause of Electrical motions.

CHAP. XX.

Of the Loadstones generation; and its particular motions.

1. The extreme heat of the Sun under the Zodiack, draweth a stream of air from each Pole into the Torrid Zone.
2. The atomes of these two streams coming together are apt to incorporate with one another.
3. By the meeting and mingling together of these streams at the Equator, divers rivolets of atoms of each Pole, are continuated from one Pole to the other.
4. Of these atoms incorporated with some fit matter in the bowels of the earth, is made a stone.
5. This stone worketh by emanations, joyned with agreeing streams that meet them in the air: and in fine it is a loadstone.
6. A method for making experiences upon any subject.
7. The loadstones generation by atomes flowing from both Poles, is confirmed by experiments observed in the stone it self.
8. Experiments to prove that the loadstone worketh by emanations, meeting with agreeing streams.

CHAP.

CHAP. XXI.

Positions drawn out of the former doctrine, and confirmed by expetimental proofe.

1. *The operations of the loadſtone are wrought by bodies and not by qualities.*
2. *Objections againſt the former poſition anſwered.*
3. *The loadſtone it imbued with his virtue from another body.*
4. *The virtue of the loadſtone is a double, and not one ſimple virtue.*
5. *The vritue of the loadſtone worketh more ſtrongly in the Poles of it, than in any other par.*
6. *The loadſtone ſendeth forth its emanations ſpherically. Which are of two kinds: and each kind is ſtrongeſt in that hemiſphere, through whoſe polary parts they iſſue out.*
7. *Putting two loadſtones within the ſphere of one another, every part of one loadſtone doth not agree with every part of the other loadſtone.*
8. *Concerning the declination and other reſpects of a needle, towards the loadſtone it toucheth.*
9. *The virtue of the loadſtone goeth from end to end in lines almoſt parallel to the axis.*
10. *The virtue of a loadſtone is not perfectly ſpherical though the ſtone be ſuch.*
11. *The intention of nature in all the operations of the loadſtone, is to make an union betwixt the attractive and the attracted bodies.*
12. *The main globe of the earth not a loadſtone.*
13. *The loadſtone is generated in all parts or climates of the earth.*
14. *The conformity betwixt the two motions of magnetick things, and of heavy things.*

CHAP. XXII.

A ſolution of certain Problemes concerning the loadſtone, and a ſhort ſum of the whole doctrine touching it.

1. *Which is the North, and which the South Pole of a loadſtone.*
2. *Whether any bodies beſides magnetick ones be attractive.*
3. *Whether an iron placed perpendicularly towards the earth doth get a magnetical virtue of pointing towards the north, or towards the ſouth in that end that lieth downwards.*
4. *Why loadſtones affect iron better than one another.*
5. Gilberts *reaſon refuted touching a capped loadſtone, that taketh up more iron than one not capped; and an iron impregnated that in ſome caſe draweth more ſtrongly than the ſtone it ſelf.*
6. Galileus *his opinion touching*

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6. Galileus *his opinion touching*

the former effects refuted.
7. The Authours solution to the former questions.
8. The reason why in the former case, a lesser loadstone doth draw the interjacent iron from the greater.
9. Why the variation of a touched needle from the north, is greater the nearer you go to the Pole.
10. Whether in the same part of the world a touched needle may at one time varie more from the north, and at another time less.
11. The whole doctrine of the loadstone summed up in short.

CHAP. XXIII.

A description of two sorts of living creatures; Plants and animals: & how they are framed in common to perform vital motion.

1. The connexion of the following Chapters with the precedent ones.
2. Concerning several compositions of mixed bodies.
3. Two sorts of living creatures.
4. An engine to express the first sort of living creatures.
5. An other engine by which may be expressed the second sort of living creatures.
6. The two former Engines and some other comparisons applyed to express the two several sorts of living creatures.
7. How plants are framed.
8. How sensitive creatures are formed.

CHAP. XXIV.

A more particular survey of the generation of Animals, in w is discovered what part of the animals is first generated.

1. The opinion that the seed containeth formally every part of the parent.
2. The former opinion rejected.
3. The Authours opinion of this question.
4. Their opinion refuted, who hold that every thing containeth formally all things.
5. The Authors opinion concerning the generation of Animals declared and confirmed.
6. That one substance is changed into another.
7. Concerning the hatching of chickens, and the generation of other animals.
8. From whence it happeneth that the deficiences or excrescences of the parents body, are often seen in their children.
9. The difference between the authours opinion, and the former one.
10. That the heart is imbued with the general specifick virtues of the whole body; whereby is confirmed the doctrine of the two former paragraphs.
11. That

11. *That the heart is the first part generated in a living creature.*

CHAP. XXV.

How a Plant or Animal cometh to that figure it hath.

1. *That the figure of an Animal is produced by ordinary second causes, as well as any other corporeal effect.*
2. *That the several figures of bodies proceed from a defect in one of the three dimensions, caused by the concurrence of accidental causes.*
3. *The former doctrine is confirmed by several instances.*
4. *The same doctrine applyed to Plants,*
5. *The same doctrine declared in leafs of trees.*
6. *The same applyed to the bodies of animals.*
7. *In what sense the Author doth admit of* Vis formatrix.

CHAP. XXVI.

How motion begineth in living creatures. And of the motion of the heart, circulation of the bloud, Nutrition, Augmentation, and corruption or death.

1. *From whence doth proceed the primary motion and growth in plants.*
2. Monsieur des Cartes *his opinion touching the motion of the heart.*
3. *The former opinion rejected.*
4. *The Authors opinion concerning the motion of the heart.*
5. *The motion of the heart dependeth originally of its fibers irrigated by blood.*
6. *An objection answered against the former doctrine.*
7. *The circulation of the blood & other effects that follow the motion of the heart.*
8. *of Nutrition.*
9. *of Augmentation.*
10. *Of death and sicknels.*

CHAP. XXVII.

Of the motions of sense, and of the sensible qualities in general and in particular of those wch belong to Touch, Taste, and Smelling.

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5. *From*

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The conclusion of the [illegible]

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The Preface. Of simple Apprehensions.

1. *What is a right apprehension of a thing.*
2. *The very thing it self is truly in his understanding, who rightly apprehendeth it.*
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5. *The apprehension of a* thing *is in next degree to that of* Being, *and it is the* Basis *of all the subsequent ones.*
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8. *That* Existence *or* Being *is the proper affection of man: and that mans soul is a comparing power.*
9. *A thing by coming into the understanding of man, loseth nothing of its own peculiar nature.*
10. *A multitude of things may be united in mans understanding without being mingled or confounded together.*
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1. *How a judgement is made by the understanding.*
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4. *That a settled judgement becometh a part of our soul.*
5. *How the soul cometh to deem or settle a judgement.*
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8. *Why truth is the perfection of a reasonable soul: and why it is not found in simple apprehensions as well as in Enuntiations.*
9. *What is a solid judgement, and what a slight one.*
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1. *How discourse is made.*
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3. *That the life of man as man, doth consist in discourse, and of the vast extent of it.*
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8. *Of Rhetorick.*
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1. *That humane actions proceed from two several principles, understanding and sense.*
2. *How our general and inbred maxims do concur to humane action.*
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2. *The existence of corporeal things in the soul by the power of apprehension, doth prove her to be immaterial.*
3. *The notion of being, which is innate in the soul, doth prove the same.*
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5. *That*

5. That corporeal things are ſpiritualized in the underſtanding, by means of the ſouls working in and by reſpects.
6. That the abſtracting of notions from all particular and individual accidents, doth prove the immateriality of the ſoul.
7. That the univerſality of abſtracted notions do prove the ſame.
8. That collective apprehenſions do prove the ſame.
9. The operations of the ſoul drawing alwaies from multitude to unity, do prove the ſame.
10. The difference betwixt the notion of a thing in our underſtanding, and the impreſſion that correſpondeth to the ſame thing in our fanſie, doth prove the ſame.
11. The apprehenſion of negation and privations do prove the ſame

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1. The manner of judging or deeming by apprehending two things to be identified, doth prove the ſoul to be immaterial.
2. The ſame is proved by the manner of apprehending oppoſition in a negative judgement.
3. That things in themſelves oppoſite to one another having no oppoſition in the ſoul, doth prove the ſame.
4. That the firſt truths are identified to the ſoul.
5. That the ſoul hath an infinite capacity, and conſequently is immaterial.
6. That the oppoſition of contradictory propoſitions in the ſoul doth prove her immateriality.
7. How propoſitions of eternal truth, do prove the immateriality of the ſoul.

CHAP. VII.

That our diſcourſing doth prove our ſoul to be incorporeal.

1. That in diſcourſing the ſoul containeth more in it at the ſame time then is in the fantaſie, which proveth her to be immaterial.
2. That the nature of diſcourſe doth prove the ſoul to be ordered to infinite knowledge, and conſequently immaterial.
3. That the moſt natural objects of the ſoul are immaterial and conſequently the ſoul her ſelf is ſuch.

CHAP. VIII.

Containing proofs out of our manner of proceeding to action, that our ſoul is incorporeal

1. That the ſouls being a power to order things, proveth her to be immaterial.

2. That the ſouls being able to move without being moved, doth prove her to be immateriall.
3. That the ſouls proceeding to action with an univerſality, and indifferency, doth prove the ſame.
4. That the quiet proceeding of reaſon doth prove the ſame.
5. A concluſion of what hath been ſaid hitherto in this ſecond Treatiſe.

CHAP. IX.

That our ſoul is a *Subſtance*, and *Immortal*.

1. That Mans ſoul is a ſubſtance.
2. That man is compounded of ſome other ſubſtance beſides his body.
3. That the ſoul doth ſubſiſt of it ſelf independently of the body.
4. Two other argumants to preve the ſame: one poſitive, the other negative.
5. The ſame is proved becauſe the ſoul cannot be obnoxious to the cauſe of mortality.
6. The ſame is proved becauſe the ſoul hath no contrary.
7. The ſame is proved from the end, for which the ſoul was created.
8. The ſame is proved becauſe ſhe can move without being moved.
9. The ſame is proved from her manner of operation which is grounded in being.
10. Laſtly, it is proved from the ſcience of Moralitiy, the principles whereof would be deſtroyed, if the ſoul were mortal.

CHAP. X.

Declaring what the ſoul of a man ſeparated from his body, is: and of her knowledge and manner of working.

1. That the ſoul is one ſimple knowing act, which is a pure ſubſtance, and nothing but ſubſtance.
2. That a ſeparated ſoul is in no place, and yet is not abſent from any place.
3. That a ſeparated ſoul is not in time, nor ſubject to it.
4. That the ſoul is an active ſubſtance, and all in it is activity.
5. A deſcription of the ſoul.
6. That a ſeparated ſoul knoweth all that which ſhe knew whileſt ſhe was in her body.
7. That the leaſt knowledge which the ſoul acquireth in her body of any one thing, doth cauſe in her, when ſhe is ſeparated from her body, a compleat knowledge of all things whatſoever.
8. An anſwer to the objections of ſome Peripatetick, who main-

tain

tain the ſoul to periſh with the body.
9. *The former Peripatetick refuted out of* Ariſtotle.
10. *The operations of a ſeparated ſoul compared to her operations in her body.*
11. *That a ſeparated ſoul is in a ſtate of pure being, and conſequently immortal.*

CHAP. XI.

Shewing what effects the divers manners of living in this world do cauſe in a ſoul, after ſhe is ſeparated from her body

1. *That a ſoul in this life is ſubject to mutation, and may be perfected in knowledge.*
2. *That the knowledges which a ſoul getteth in this life, will make her knowledge in the next life more perfect and firm.*
3. *That the ſouls of men addicted to ſcience whileſt they lived here, are more perfect in the next world, than the ſouls of unlearned men.*
4. *That thoſe ſouls which embrace virtue in this world, will be moſt perfect in the next; and thoſe which embrace vice, moſt miſerable.*
5. *The ſtate of a vicious ſoul in the next life.*
6. *The fundamental reaſon why as well happineſs as miſery is ſo exceſſive in the next life.*
7. *The reaſon why mans ſoul requireth to be in a body, and to live for ſome ſpace of time joyned with it.*
8. *That the miſery of the ſoul in the next world proceedeth out of inequality, and not out of falſity of her judgements.*

CHAP. XII.

Of the perſeverance of a ſoul, in the ſtate ſhe findeth her ſelf in, at her firſt ſeparation from her body.

1. *The explication, and proof of that maxim, that,* If the cauſe be in act, the effect muſt alſo be.
2. *The effects of all ſuch agents as work inſtantaneouſly, are compleat in the firſt inſtant that the agents are put.*
3. *All pure ſpirits do work inſtantaneouſly.*
4. *That a ſoul ſeparated from her body, cannot ſuffer any change after the firſt inſtant of her ſeparation.*
5. *That temporal ſins are juſtly puniſhed with eternal pains.*

The Concluſion.

THE

CHAP. XI.

The Conclusion.

THE

THE FIRST TREATISE DECLARING *THE NATURE AND OPERATION OF* BODIES.

CHAP. I.

A Preamble to the whole discourse: Concerning Notions in general.

IN delivering any Science, the clearest and smoothest method, and most agreeable to nature, is to begin with the consideration of those things that are most common and obvious; and by the dissection of them to descend by orderly degrees and steps (as they lie in the way) unto the examination of the most particular and remote ones. Now in our present intended survey of a Body, the first thing which occurreth to our sense in the perusal of it, is its *Quantity*, bulk, or magnitude: and this seemeth by all mankinde to be conceived so inseparable from a body, as when a man would distinguish a corporeal substance from a spiritual one (which is accounted indivisible) he naturally pitcheth upon an apprehension of its having bulk, and being solid, tangible, and apt to make impression upon our outward senses; according to that expression of *Lucretius*, who studying Nature in a familiar and rational manner telleth us, *Tangere enim & tangi, nisi corpus nulla potest res*: And therefore in our inquiry of Bodies, we will observe that plain method which Nature teacheth us, and will begin with examining, *What Quantity is*, as being their

1. *Quantity* is the first and most obvious affection of a Body.

first an primary affection; and that which maketh the things we treat of, be what we intend to signifie by the name of Body.

2. Words do not express things as they are in themselves, but onely as they are painted in the the mindes of men.

But because there is a great variety of apprehensions framed by learned men of the nature of *Quantity* (though indeed nothing can be more plain and simple than it is in it self) I conceive it will not be amisse, before we enter into the explication of it, to consider how the mystery of discoursing and expressing our thoughts to one another by words (a prerogative belonging onely to a man) is ordered and governed among us; that so we may avoid those rocks, which many, and for the most part, such as think they spin the finest threds, do suffer shipwrack against in their subtilest discourses. The most dangerous of all which, assuredly is when they confound the true and real natures of things, with the conceptions they frame of them in their own mindes. By which fundamental miscarriage of their reasoning, they fall into great errors and absurdities: and whatsoever they build upon so ruinous a foundation, proveth but useless cobwebs or prodigious Chymeras. It is true, words serve to expresse things; but if you observe the matter well, you will perceive they do so, onely according to the pictures we make of them in our own thoughts, and not according as the things are in their proper natures. Which is very reasonable it should be so, since the soul, that giveth the names, hath nothing of the things in her but these notions: and knoweth not the things otherwise than by these notions; and therefore cannot give other names but such as must signifie the things by mediation of these notions. In the things, all that belongeth unto them is comprised under one entire Entity: but in us, there are framed as many several distinct formal conceptions, as that one thing sheweth it self unto us with different faces. Every one of which conceptions seemeth to have for its object a distinct thing, because the conception it self is as much severed and distinguished from another conception or image, arising out of the very same thing that begot this, as it can be from any image painted in the understanding by an absolutely other thing.

3. The first error that may arise from hence;

It will not be amisse to illustrate this matter by some familiar example. Imagine I have an apple in my hand: the same fruit worketh different effects upon my several senses: my eye telleth

telleth me it is green or red: my nose that it hath a mellow scent: my taste that it is sweet; and my hand that it is cold and weighty. My senses thus affected, send messengers to my phantasie with news of the discoveries they have made: and there, all of them make several and distinct pictures of what entereth by their doors. So that my Reason (which discourseth upon what it findeth in my phantasie) can consider greenness by it self, or mellowness, or sweetness, or coldness, or any other quality whatsoever, singly and alone by it self, without relation to any other that is painted in me by the same apple: in which, none of these have any distinction at all, but are one and the same substance of the apple, that maketh various and different impressions upon me, according to the various dispositions of my several senses: as hereafter we shall explicate at large. But in my minde, every one of these notions is a distinct picture by it self, and is as much severed from any of the rest arising from the same apple, as it would be from any impression or image made in me, by a stone or any other substance whatsoever, that being entire in it self and circumscribed within its own circle, is absolutely sequestred from any communication with the other: so that what is but one entire thing in it self, seemeth to be many distinct things in my understanding: whereby, if I be not very cautious, and in a manner wrestle with the bent and inclination of my understanding (which is apt to referre the distinct and compleat stamp it findeth within it self, unto a distinct and compleat original character in the thing) I shall be in danger before I am aware, to give actual beings to the quantity, figure, colour, smell, taste, and other accidents of the apple, each of them distinct one from another, as also from the substance which they cloath; because I finde the notions of them really distinguished (as if they were different Entities) in my minde. And from thence I may inferre, there is no contradiction in nature to have the accidents really severed from one another, and to have them actually subsist without their substance: and such other mistaken subtilties, which arise out of our unwary conceiving that things are in their own natures after the same fashion as we consider them in our understanding.

which is a multiplying of things, where no such multiplication is really found.

4. A second error; the conceiving of many distinct things as really one thing.

And this courle of the mindes disguising and changing the impressions it receiveth from outward objects, into appearances quite differing from what the things are in their own real natures, may be observed not onely in multiplying Entities where in truth there is but one: but also in a contrary manner, by comprising several distinct things under one single notion; which if afterwards it be reflected back upon the things themselves, is the occasion of exceeding great errours, and entangleth one in unsuperable difficulties. As for example: Looking upon several cubes or dyes, whereof one is of Gold, another of Lead, a third of Ivory, a fourth of Wood, a fifth of Glasse, and what other matter you please; all these several things agree together in my understanding, and are there comprehended under one single notion of a cube; which (like a Painter that were to designe them onely in black and white) maketh one figure that representeth them all. Now if removing my consideration from this impression which the several cubes make in my understanding, unto the cubes themselves, I shall unwarily suffer my self to pin this one notion upon every one of them, and accordingly conceive it to be really in them; it will of necessity fall out by this misapplying of my intellectual notion to the real things, that I must allow Existence to other entities, which never had nor can have any in nature.

From this conception, *Plato's* Ideas had their birth; for he finding in his understanding one universal notion that agreed exactly to every individual of the same species of substance, which imprinted that notion in him; and conceiving that the picture of any thing must have an exact correspondence with the thing it representeth; and not considering that this was but an imperfect picture of the individual that made it: he did thence conceive, there was actually in every individual substance one universal Nature running through all of that species, which made them be what they were. And then considering that corporeity, quantity, and other accidents of matter, could not agree with this universal subsistent Nature, he denied all those of it: and so, abstracting from all materiality in his Ideas, and giving them a real and actual subsistence in nature, he made them like Angels, whose essences and formal reasons were to be the

the Essence and to give Existence unto corporeal individuals: and so each Idea was embodied in every individual of its specie. Unto which opinion (and upon the same grounds) *Averroes* did lean, in the particular of mens souls. Likewise *Scotus* finding in his understanding an universal notion springing from the impression that individuals make in it, will have a like universal in the thing it self, so determining universals (to use his own language and terms) to be *à parte rei*; and expressing the distinction they have from the rest of the thing, by the terms of *actu formaliter, sed non realiter*: and thereby maketh every individual comprise an universal subsistent nature in it. Which inconvenience other moderne Philosophers seeking to avoid, will not allow these universals a real and actual subsistence; but will lend them onely a fictitious Being, so making them as they call them *Entia rationis*. But herein again they suffer themselves to be carried down the stream before they are aware by the understanding (which is apt to pin upon the objects, the notions it findeth within it self resulting from them) and do consider an unity in the things, which indeed is onely in the understanding.

5. Great care to be taken to avoid the errours which may arise from our manner of understanding things.

Therefore one of our greatest cares in the guidance of our discourse, and a continual and sedulous caution therein, ought to be used in this particular, where every errour is a fundamental one, and leadeth into inextricable labyrinths, and where that which is all our level to keep us upright and even (our understanding) is so apt, by reason of its own nature and manner of operation, to make us slide into mistaking and errour. And to sum up in short what this discourse aimeth at, we must narrowly take heed, lest reflecting upon the notions we have in our mind, we afterwards pin those airy superstructures upon the material things themselves, that begot them; or frame a new conception of the nature of any thing by the negotiation of our understanding, upon those impressions which it self maketh in us: whereas we should acquiesce and be content with that natural and plain notion, which springeth immediately and primarily from the thing it self: which when we do not, the more we seem to excell in subtilty, the farther we go from reality and truth; like an arrow, which being wrong levelled at hand, falleth widest when shot in the strongest bow.

6. Two sorts of words to express our notions; the one common to all men, the other proper to Scholars.

Now to come to another point that maketh to our present purpose. We may observe there are two sorts of language to express our notions by: The one belongeth in general to all mankind, and the simplest person, that can but apprehend and speak sense, is as much judge of it, as the greatest Doctor in the Schools: and in this the words express the things properly and plainly, according to the natural conceptions that all people agree in making of them. The other sort of language is circled in with narrower bounds; and is understood onely by those that in a particular and express manner have been trained up unto it: and many of the words which are proper to it have been, by the authors of it, translated and wrested from the general conceptions of the same words, by some metaphor, or similitude, or allusion, to serve their private turns. Without the first manner of expressing our notions, mankind could not live in society together, and converse with one another: whereas, the other hath no farther extent, than among such persons as have agreed together to explicate and design among themselves particular notions peculiar to their arts and affairs.

Of the first kinde, are those ten general heads, which *Aristotle* calleth Predicaments: under which he (who was the most judicious orderer of notions, and director of mens conceptions, that ever lived) hath comprised whatsoever hath, or can have a being in nature. For when any object occurreth to our thoughts, we either consider the essential and fundamental Being of it; or we refer it to some species of Quantity; or we discover some qualities in it; or we perceive that it doth, or that it suffereth something; or we conceive it in some determinate place, or time, and the like. Of all which, every man living that enjoyeth but the use of reason, findeth naturally within himself at the very first naming of them, a plain, compleat, and satisfying notion; which is the same, without any the least variation, in all mankind: unless it be in such, as have industriously, and by force, and with much labour, perplexed and depraved those primary and sincere impressions, which nature had freely made in them.

Of the second sort, are the particular words of art, by which

which learned men use to express what they mean in Sciences; and the names of Instruments, and of such things as belong to trades, and the like: as a sign, a tangent, an epicycle, a deferent, an axe, a trowel, and such others; the intelligence of which belongeth not to the generality of man-kinde; but onely to Geometricians, Astronomers, Carpenters, Masons, and such persons as converse familiarly and frequently with those things. To learn the true signification of such words, we must consult with those that have the knowledge and practice of them: as in like manner, to understand the other kinde of plain language, we must observe how the words that compose it are apprehended, used, and applied by mankinde in general; and not receive into this examination the wrested or Metaphorical senses of any learned men, who seek oftentimes (beyond any ground in nature) to frame a general notion that may comprehend all the particular ones, which in any sense, proper or improper, may arise out of the use of one word.

7. Great errors arise by wresting words from their common meaning to express a more particular or studied notion.

And this is the cause of great errors in discourse; so great and important, as I cannot too much inculcate the caution requisite to the avoiding of this rock. Which that it may be the better apprehended, I will instance in one example of a most plain and easie conception, wherein all mankinde naturally agreeth, how the wresting it from its proper, genuine, and original signification, leadeth one into strange absurdities; and yet they pass for subtil speculations. The notion of being in a place, is naturally the same in all men living: ask any simple artizan, Where such a man, such a house, such a tree, or such a thing is; and he will answer you in the very same manner as the learnedst Philosopher would do: he will tell you, the man you ask for, is in such a church, sitting in such a pew, and in such a corner of it; that the house you enquire after, is in such a street, and next to such two buildings on each side of it; that the tree you would finde out, is in such a forest, upon such a hill, near such a fountain, and by such a bush; that the wine you would drink of, is in such a cellar, in such a part of it, and in such a cask. In conclusion, no man living that speaketh naturally and freely out of the notion he findeth clearly in his understanding, will give you

other answer to the question of, *Where a thing is*, than such a one as plainly expresseth his conceit of being in place, to be no other, than a bodies being environed and inclosed by some one, or several others that are immediate unto it; as the place of a liquour, is the vessel that containeth it; and the place of the vessel, is such a part of the chamber or house that it resteth upon, together with the ambient air; which hath a share in making up the places of most things. And this being the answer, that every man whatsoever will readily give to this question; and every asker being fully satisfied with it; we may safely conclude, That all their notions and conceptions of being in a place, are the same; and consequently, that it is the natural and true one.

But then some others, considering that such conditions as these will not agree unto other things, which they likewise conceit to be in a place (for they receive it as an axiome from their sence, that whatsoever is, must be somewhere, and whatsoever is no where, is not at all) they fall to casting about how they may frame some common notion to comprehend all the several kinds of being in place, which they imagine in the things they discourse of. If there were nothing but bodies to be ranked by them in the Predicament of Place, then that description I have already set down would be allowed by them, as sufficient. But since that spirits and spiritual things (as Angels, rational souls, verities, sciences, arts, and the like) have a being in nature; and yet will not be comptised in such a kind of place as a body is contained in; they rack their thoughts to speculate out some common notion of being in place, which may be common to these, as well as to bodies; like a common accident agreeing to divers subjects. And so in the end, they pitch upon an Entity, which they call an *Ubi*: and they conceit the nature and formal reason of that to be, the ranking of any thing in a place, when that Entity is thereunto affixed. And then they have no farther difficulty, in setling an Angel, or any pure spirit, or immaterial essence, in a place as properly, and as compleatly, as if it were a corporeal substance. It is but assigning an *Ubi* to such a spirit, and he is presently riveted to what place you please: and by multiplying the *Ubies*, any

any individual body unto which they are assigned, is at the same instant in as many distant places, as they allot it different *Vbies*: and if they assign the same *Vbi* to several bodies, so many several ones as they assigne it unto will be in one and the same place: and not onely many bodies in one place, but even a whole body in an indivisible, by a kind of *Vbi* that hath a power to resume all the extended parts, and inclose them in a point of place. All which prodigious conceits and impossibilities in nature, do spring out of their mistake in framing Metaphysical and abstracted conceptions, instead of contenting themselves with those plain, easie, and primary notions, which nature stampeth alike in all men of common sence, and understanding. As who desireth to be farther instructed in this particular, may perceive, if he take the pains to look over what M. *White* hath discoursed of *place*, in the first of his Dialogues *De Mundo*. Unto which book I shall from time to time (according as I shall have occasion) refer my Reader in those subjects the Authour taketh upon him to prove; being confident, that his metaphysical demonstrations there, are as firm as any Mathematical ones (for Metaphysical demonstrations have in themselves as much firmness, certainty and evidencie as they) and so will appeare as evident as they, unto whosoever shall understand them throughly, and shall frame right conceptions of them: which (how plain soever they seem to be) is not the work of every pretender to learning.

CHAP. II.

Of Quantity.

P. We must know the vulgar and common notion of Quantity, that we may understand the nature of it.

AMong those primary affections which occur in the perusal of a body, *Quantity* (as I have observed in the precedent chapter) is one, and in a manner the first and the root of all the rest. Therefore (according to the caution we have been so prolix in giving, because it is of so main importance) if we aim at right understanding the true nature of it, we must examine, what apprehension all kinds of people (that is, mankind in general) maketh of it. By which proceeding, we do not make the ignorant multitude judge of that learning wich groweth out of the consideration of Quantity: but one-

ly of the natural notion which serveth learned men for a basis and foundation to build scientifical superstructures upon. For although Sciences be the works and structures of the understanding, governed and levelled by the wary and strict rules of most ingenuous artificers, yet the ground upon which they are raised, are such plain notions of things, as naturally and without any art, do present themselves to every mans apprehension: without which for matter to work upon, those artificial reflections would leave the understanding as unsatisfied, as a cook would the appetite by a dish upon which he should have exercised all his art in dressing it, but whose first substance were not meat of solid nutriment: it is the coarse market that must deliver him plain materials to employ his cunning upon: And in like manner, it is the indisciplined multitude that must furnish learned men with natural apprehensions, and notions to exercise their wits about: which when they have, they may use and order and reflect upon them as they please: but they must first receive them in that plain and naked form, as mankind in general pictureth them out in their imaginations.

And therefore the first work of Scholars is to learn of the people, *Quem penes arbitrium est & jus & norma loquendi*, what is the true meaning and signification of these primary names, and what notions they beget in the generality of mankind of the things they design. Of the common people then we must enquire, *What Quantity is:* and we shall soon be informed, if we but consider what answer any sensible man will make upon the sudden to a question whereof that is the subject: for such unstudied replies express sincerely the plaine and natural conceptions which they that make them have of the things they speak of. And this of Quantity is the plainest and the first that nature printeth in us, of all the things we see, feel, and converse withall; and that must serve for a ground unto all our other inquiries and reflections: for which cause we must be sure not to receive it wrested or disguised from its own nature.

2. Extension or divisibility is the common notion of Quantity:

If then any one be asked, What Quantity there is in such a thing, or how great it is; he will presently in his understanding compare it with some other thing (equally known by both parties)

parties) that may serve for a measure unto it; and then answer, That it is as big as it, or twice as big, or not half so big, or the like: in fine, that it is bigger or lesser than another thing, or equal to it.

It is of main importance, to have this point throughly and clearly understood: therefore it will not be amiss to turne it and view it a little more particularly. If you ask what quantity there is of such a parcel of cloth, how much wood in such a piece of timber, how much gold in such an ingot, how much wine in such a vessel, how much time was taken up in such an action? he that is to give you an account of them, measureth them by ells, by feet, by inches, by pounds, by ounces, by gallons, by pints, by days, by hours, and the like; and then telleth you, how many of those parts are in the whole that you enquire of. Which answer, every man living will at the instant, without study, make to this question; and with it, every man that shall ask will be fully appayed and satisfied: so that it is most evident, it fully expresseth the notions of them both, and of all mankind, in this particular.

Wherefore, when we consider that Quantity is nothing else, but the extension of a thing; and that this extension is expressed by a determinate number of lesser extensions of the same nature; (which lesser ones, are sooner and more easily apprehended than greater; because we are first acquainted and conversant with such; and our understanding graspeth, weigheth and discerneth such more steadily; and maketh an exacter judgement of them) and that such lesser ones are in the greater which they measure, as parts in a whole; and that the whole by comprehending those parts, is a meer capacity to be divided into them; we conclude, That, *Quantity* or *Bigness*, is nothing else but divisibility; and that a thing is big, by having a capacity to be divided, or (which is the same) to have parts made of it.

This is yet more evident (if more may be) in Discreet Quantity (that is, in *number*) than in continued Quantity, or extension. For if we consider any number whatsoever, we shall find the essence of it consisteth in a capacity of being resolved and divided into so many unities, as are contained in it; which are the parts of it. And this species of Quantity being simpler than the other, serveth for a rule to determine it by: as we may observe

observe in the familiar answers to questions of continued Quantity, which expresse by number the content of it: as when one delivereth the Quantity of a piece of ground, by such a number of furlongs, acres, perches, or the like.

3. Parts of Quantity are not actually in their whole.

But we must take heed of conceiving, that those parts, which we consider to discerne the nature of Quantity, are actually and really in the *whole* of any continued one that containeth them. Ells, feet, inches, are no more reall Entities in the *whole* that is measured by them, and that maketh impressions of such notions in our understanding; than in our former example, colour, figure, mellowness, taste, and the like, are several substances in the apple that affecteth our several senses with such various impressions. It is but one *whole* that may indeed be cut into so many several parts: but those parts are not really there, till by division they are parcelled out: and then, the *whole* (out of which they are made) ceaseth to be any longer: and the parts succeed in lieu of it; and are every one of them a new whole.

This truth is evident out of the very definition we have gathered of Quantity. For since it is *divisibility* (that is, a bare capacity to division) it followeth, that it is not yet divided: and consequently, that those parts are not yet in it, which may be made of it; for division, is the making two or more things of one.

4. If parts were actually in their whole, Quantity would be compoſed of indivisibles.

But because this is a very great controversie in schools, and so important to be determined and setled, as without doing so, we all be lyable to maine errors in searching the nature and operations of bodies; and that the whole progress of our discourse, will be uncertaine and wavering, if this principle and foundation be not firmly laid; we must apply our selves, to bring some more particular and immediate proof of the verity of this assertion. Which we will do, by shewing the inconvenience, impossibility and contradiction, that the admittance of the other leadeth unto. For if we allow actual parts to be distinguished in Quantity, it will follow that it is compoſed of points or indivisibles, which we shall prove to be impossible.

The first will appear thus: if Quantity were divided into all the parts into which it is divisible, it would be divided into indivisibles (for nothing divisible, and not divided, would remain in it) but it is distinguished into the same parts, into which

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it would be divided, if it were divided into all the parts into which it is divisible; therefore it is distinguished into indivisibles. The major Proposition is evident to any man that hath eyes of understanding. The minor is the confession or rather the position of the adversary, when he saith that all its parts are actually distinguished. The consequence cannot be calumniated, since that indivisibles, whether they be separated or joyned, are still but indivisibles; though that which is composed of them be divisible. It must then be granted that all the parts which are in Quantity, are indivisibles; which parts being actually in it, and the whole being composed of these parts onely, it followeth, that Quantity is composed and made of indivisibles.

If any should cavil at the supposition, and say, we stretch it farther than they intend it, by taking *all* the parts to be distinguished; whereas they mean onely that there are parts actually in Quantity, abstracting from *all*: by reason that *all*, in this matter, would inferre an infinity, which to be actually in any created thing, they will allow to be impossible. Our answer will be, to represent unto them how this is barely said, without any ground or colour of reason, meerly to evade the inconvenience that the argument driveth them unto. For if any parts be actually distinguished, why should not all be so? What prerogative have some that the others have not? And how came they by it? If they have their actual distinction out of their nature of being parts, then all must enjoy it alike, and all be equally distinguished, as the supposition goeth: and they must all be indivisibles, as we have proved. Besides, to prevent the cavil upon the word *all*, we may change the expression of the Proposition into a negative: for if they admit (as they do) that there is no part in Quantity, but is distinguished as far as it may be distinguished, then the same conclusion followeth with no lesse evidence; and all will prove indivisibles, as before.

But it is impossible that indivisibles should make Quantity; for if they should, it must be done either by a finite and determinate number, or by an infinite multitude of them. If you say by a finite; let us take (for example) three indivisibles, and by adding them together, let us suppose a line to be composed; whose extent being onely longitude, it is the first and simplest species of Quantity, and therefore whatsoever is divisible into parts

5. Quantity cannot be composed of indivisibles.

parts, must be at the least a line. This line thus made, cannot be conceived to be divided into more parts than into three; since doing so you reduce it into the indivisibles that composed it. But *Euclide* hath demonstratively proved beyond all cavil (in the tenth Proposition of his sixth Book of Elements) that any line whatsoever may be divided into whatsoever number of parts; so that if this be a line, it must be divisible into a hundred or a thousand, or a million of parts: which being impossible in a line, that being divided into three parts onely, every one of those three is incapable of farther division: it is evident, that neither a line, nor any Quantity whatsoever, is composed or made of a determinate number of indivisibles.

And since that this capacity of being divisible into infinite parts, is a property belonging to all extension (for *Euclide*'s demonstration is universal) we must needs confesse that it is the nature of indivisibles, when they are joyned together, to be drowned in one another, for otherwise there would result a kinde of extension out of them, which would not have that property; contrary to what *Euclide* hath demonstrated. And from hence it followeth that Quantity cannot be composed of an infinite multitude of such indivisibles; for if this be the nature of indivisibles, though you put never so great a number of them together, they will still drown themselves all in one indivisible point. For what difference can their being infinite, bring to them, of such force as to destroy their essence and property? If you but consider how the essential composition of any multitude whatsoever, is made by the continual addition of unities, till that number arise; it is evident in our case that the infinity of indivisibles must also arise out of the continued addition of still one indivisible to the indivisibles presupposed: then let us apprehend a finite number of indivisibles, which (according as we have proved) do make no extension, but are all of them drowned in the first; and observing how the progresse unto an infinite multitude, goeth on by the steps of one and one, added still to this presupposed number: we shall see that every indivisible added, and consequently the whole infinity, will be drowned in the first number, as that was in the first indivisible.

Which will be yet plainer, if we consider that the nature of extension

extenſion requireth that one part be not in the ſame place, where the other is: then if this extenſion be compoſed of indiviſibles, let us take two points of place in which this extenſion is, and inquire whether the indiviſibles that are in each one of theſe points, be finite or infinite. If it be anſwered that they are finite, then the finite indiviſibles in theſe two points make an extenſion; which we have proved impoſſible. But if they be ſaid to be infinite; then infinite indiviſibles are drowned in one point, and conſequently have not the force to make extenſion. Thus then it remaineth firmly eſtabliſhed, *That Quantity is not compoſed of indiviſibles* (neither finite, nor infinite ones) and conſequently, *That parts are not actually in it.*

6. An objection to prove that parts are actually in Quantity; with a declaration of the miſtake from whence it proceedeth.

Yet before we leave this point, although we have already been ſomewhat long about it, I conceive it will not be tedious, if we be yet a little longer, and bend our diſcourſe to remove a difficulty that even Senſe it ſelf ſeemeth to object unto us. For doth not our eye evidently inform us, there are fingers, hands, arms, legs, feet, toes and variety of other parts in a mans body? Theſe are actually in him, and ſeem to be diſtinct things in him, ſo evidently, that we cannot be perſwaded, but that we ſee, and feel the diſtinction between them; for every one of them hath a particular power of actual working and doing what belongeth unto its nature to do: each finger is really there; the hand is different from the foot; the leg from the arm; and ſo of the reſt. Are not theſe parts then actually and really in a mans body? And is not each of them as really diſtinguiſhed from any other.

This appeareth at the firſt ſight to be an inſuperable objection, becauſe of the confirmation and evidence that ſenſe ſeemeth to give it. But looking neerly into the matter, we ſhall finde that difficulty ariſeth not from what ſenſe informeth us of; but from our wrong applying the conditions of our notions unto the things that make impreſſions upon our ſenſe. Senſe judgeth not which is a finger, which is a hand, or which is a foot. The notions agreeing to theſe words, as well as the words themſelves, are productions of the underſtanding: which conſidering, ſeveral impreſſions made upon the ſenſe by the ſame thing as it hath a virtue and power to ſeveral operations, frameth ſeveral notions of it: as in our former example, it doth

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of colour, figure, taste, and the like, in an apple. For as these are not different bodies or substances, distinguished one from another; but are the same one entire thing, working severally upon the senses, and that accordingly, maketh these different pictures in the minde; which are there as much distinguished, as if they were pictures of different substances. So, the parts which are considered in Quantity, are not divers things, but are onely a virtue or power to be divers things: which virtue, making several impressions upon the senses, occasioneth several notions in the understanding; and the understanding is so much the more prone to conceive those parts as distinct things, by how much Quantity is neerer to be distinct things, than the qualities of the apple are. For Quantity, is a possibility to be made distinct things by division: whereas the others are but a virtue to do distinct things. And yet (as we have touched above) nothing can be more manifest, than that if Quantity be divisibility (which is a possibility, that many things may be made of it) these parts are not yet divers things. So that, if (for example) a rod be laid before us, and half of it be hid from our sight, and the other half appear; it is not one part or thing that sheweth it self, and another part or thing that doth not shew it self: but it is the same rod or thing, which sheweth it self according to the possibility of being one new thing, but doth not shew it self according to the possibility of being the other of the two things it may be made by division. Which example if it be well considered will make it much more easily sink into us, that a hand, or eye, or foot, is not a distinct thing by it self; but that it is the man, according as he hath a certain virtue or power in him to distinct operations. For if you sever any of these parts from the whole body; the hand can no more hold; nor the eye see; nor the foot walk; which are the powers that essentially constitute them to be what they are: and therefore they are no longer a hand, an eye, or a foot.

7. The solution of the former objection: and that sense cannot discern whether one part be distinguished from another, or no.

Now then to come to the objection; let us examine how far sense may be allowed to be judge in this difficulty: and we shall finde, that Sense cannot determine any one part in a body: for if it could, it would precisely tell, where that part beginneth or endeth: but it being agreed upon that it beginneth and endeth in indivisibles; it is certain, that Sense cannot determine of them.

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If then ſenſe cannot determine any one part, how ſhall it ſee that it is diſtinguiſhed from all other parts? Again, conſidering that all that whereof ſenſe is capable is diviſible, it ſtill telleth us, that in all it ſeeth, there are more parts than one: and therefore it cannot diſcern, nor inform us of any that is one alone: nor knoweth what it is to be one; for it never could diſcern it: but what is many, is many *ones* and cannot be known, by that, which knoweth not, what it is to be one: and conſequently ſenſe cannot tell us, that there are many. Wherefore it is evident, that we may not rely upon ſenſe for this queſtion. And as for reaſon, ſhe hath already given her verdict.

So that nothing remaineth but to ſhew, why we talk as we do, in ordinary diſcourſe, of many parts: and that what we ſay in that kinde, is true, notwithſtanding the unity of the thing. Which will appear plainly, if we conſider that our underſtanding hath a cuſtom for the better diſcerning of things, to impoſe upon a thing as it is under one notion, the excluſion of it ſelf as it is under other notions. And this is evident unto all Scholars, when the mark of excluſion is expreſſely put: as when they ſpeak of a white thing, adding the reduplication, *as it is white:* which excludeth all other conſiderations of that thing beſides the whiteneſſe of it: but when it cometh under ſome particular name of the thing, it may deceive thoſe that are not cunning: though indeed, moſt men diſcover it in ſuch names as we call abſtracted; as Humanity, Animality, and the like. But it eaſily deceiveth when it cometh in concrete names; as it doth in the name of *Part* in general, or in the names of particular parts; as a hand, an eye, an inch, an elle, and others of the like nature: for as you ſee that a part excludeth both the notion of the whole, and of the remaining parts; ſo doth a hand, an eye, an elle, exclude all the reſt of that thing, whereof the hand is a hand, and the elle is an elle, and ſo forth. Now then, as every man ſeeth evidently that it cannot be ſaid, the wall as it is white is plaſter or ſtone: no more can it be ſaid, that the hand of a man is his foot; becauſe the word *hand* ſignifieth as much in it ſelf, as if the man were taken, by reduplication, to be the man as he is hand, or as he hath the power of holding. So likewiſe, in the rod we ſpoke of before, it cannot be ſaid that the part ſeen is the part unſeen; becauſe the part

seen, signifieth the rod as it is a possibility to be made by division such a thing, as it appeareth to the sight. And thus it is clear how the difficulty of this point, ariseth out of the wrongfull applying the conditions of our notions, and of names, to the objects and things which we know: whereof we gave warning in the beginning. Chap. 1. §. 2, 3.

8. An enumeration of the several species of Quantity, which confirmeth that the essence of it is divisibility

After which there remaineth no more to be said of this subject, but to enumerate the several species of Quantity, according to that division which Logicians for more facility of discourse have made of it. Namely, these six, magnitude, place, motion, time, number, and weight. Of which, the two first are permanent, and lie still exposed to the pleasure of whosoever hath a minde to take a survey of them. Which he may do by measuring what parts they are divisible into; how many ells, feet, inches, a thing is long, broad, or deep; how great a place is; whether it be not bigger or lesser than such another; and by such considerations as these; which do all agree in this, that they expresse the essence of those two species of Quantity, to consist in a capacity of being divided into parts.

The two next, motion and time; though they be of a fleeting propriety, yet it is evident that in regard of their original and essential nature, they are nothing else but a like divisibility into parts; which is measured by passing over so great or so little distance; and by years, daies, hours, minutes, and the like. Number we also see is of the same nature; for it is divisible into so many determinate parts, and is measured by unities, or by lesser numbers so or so often contained in a proposed greater. And the like is evident of weight, which is divisible into pounds, ounces, drams, or grains; and by them is measured. So that looking over all the several species of Quantity; it is evident, our definition of it is a true one, and expresseth fully the essence of it, when we say it is a *divisibility*, or a capacity to be divided into parts; and that no other notion whatsoever, besides this, reacheth the nature of it.

CHAP.

CHAP. III.

Of Rarity and Density.

I Intend in this Chapter to look as far as I can into the nature and causes of the two first differences of bodies which follow out of Quantity as it concurreth with substance to make a body: for, the discovery of them, and of the various proportions of them among themselves, will be a great and important step in the journey we are going. But the scarcity of our language is such, in subjects removed from ordinary conversation, (though in others, I think none is more copious or expressive) as affordeth us not apt words of our own to express significantly such notions as I must busie my self about in this discourse. Therefore I will presume to borrow them from the Latine School, where there is much ado about them. I would express the difference between bodies, that under the same measures and outward bulk, have a greater thinness and expansion, or thickness and solidity, one than another; which terms, (or any I can finde in English) do not signifie fully those affections of Quantity that I intend here to declare: therefore I will do it under the names of Rarity and Density; the true meaning of which will appear by what we shall hereafter say.

1. What is meant by Rarity and Density.

It is evident unto us, that there are different sorts of bodies, of which though you take equal quantities in one regard, yet they will be unequal in another. Their magnitudes may be the same, but their weights will be different; or contrariwise, their weights being equal, their outward measures will not be so. Take a pinte of air; and weigh it against a pinte of water, and you will see the ballance of the last go down a main: but if you drive out the air by filling the pinte with lead, the other pinte in which the water is, will rise again as fast: which if you pour out, and fill that pinte with quickfilver, you will perceive the lead to be much lighter: and again, you will finde a pinte of gold heavier than so much Mercury. And in like manner, if you take away of the heavy bodies till they agree in weight with the lighter, they will take up and fill different proportions, and parts of the measure that shall contain them.

2. It is evident that some bodies are rare and others dense; though obscure, how they are such.

But from whence this effect ariseth, is the difficulty that we

would lay open. Our measures tell us their quantities are equal, and reason assureth us, there cannot be two bodies in one and the same place; therefore when we see that a pinte of one thing outweigheth a pinte of another that is thinner, we must conclude, that there is more body compacted together in the heavy thing than in the light: for else how could so little of a solid or dense thing be stretched out to take up so great room, as we see in a basin of water that being rarified into smoak or air, filleth a whole chamber? and again, shrink back into so little room, as when it returneth into water, or is contracted into ice? But how this comprehension of more body in equal room is effected, doth not a little trouble Philosophers.

3. A brief enumeration of the several properties belonging to the rare and dense bodies.

To finde a way that may carry us through these difficulties that arise out of the Rarity and Denfity of bodies, let us do as Astronomers when they enquire the motions of the Sphears and Planets: they take all the Phenomena or several appearances of them to our eyes; and then attribute to them such orbs, courses, and periods, as may square and fit with every one of them; and by supposing them, they can exactly calculate all that will ever after happen to them in their motions. So let us take into our consideration the chief properties of rare and dense bodies, and then cast with our selves to finde out an Hypothesis or suppofition (if it be possible) that may agree with them all.

First, It seemeth unto us, that dense bodies have their parts more close and compacted than others have that are more rare and subtil. Secondly, They are more heavy than rare ones. Again, the rare are more easily divided than the dense bodies: for water, oyl, milk, honey, and such like substances will not onely yield easily to any harder thing that shall make its way through them; but they are so apt to division and to lose their continuity, that their own weights will overcome and break it: where as in Iron, Gold, Marble, and such dense bodies, a much greater weight and force is necessary to work that effect. And indeed if we look well into it, we shall finde that the rarer things are as divisible in a lesser Quantity, as the more dense are in a greater: and the same force will break the rarer thing into more and lesser parts, than it will an equal one that is more dense. Take a stick of light wood of such a bigneſſe

ness that being a foot long, you may break it with your hands, and another of the same bigness, but of a more heavie and compacted wood, and you shall not break it, though it be two foot long: and with equal force you may break a loaf of bread into more and less parts, than a lump of lead that is of the same bigness. Which also will resist more to the division of fire (the subtilest divider that is) than so much water will; for the little atoms of fire (which we shall discourse of hereafter) will pierce and cut out in the water, almost as little parts as themselves, and mingling themselves with them they will flie away together, and so convert the whole body of water into subtil smoke: wheras the same Agent, after long working upon lead will bring it into no less parts than small graines of dust, which it calcineth it into. And gold, that is more dense than lead, resisteth peremptorily all the dividing power of fire; and will not at all be reduced into calx and lime, by such operation as reduced lead into it.

So that remembring how the nature of Quntity is Divisibility; and considering that rare things are more divisible than dense ones; we must needs acknowledge that the nature of quantity is some way more perfectly in things that are rare, than in those that are dense. On the other side, more compacted and dense things, may haply seem to some to have more Quantity than those that are rare; and that it is but shrunk together, which may be stretched out and driven into much greater dimensions than the Quantity of rare things, taking the quantities of each of them equal in outward appearance. As gold may be beaten into much more and thinner leaf, than an equal bulk of silver or lead. A wax candle will burn longer with equal light, than a tallow candle of the same bigness; and consequently, be converted into a greater quantity of fire and air. Oyl will make much more flame than spirit of wine, that is far rarer than it.

4. The opinion of those Philosophers declared, who put rarity to consist in an actual division of a Body into little parts.

These and such like consideratians have much perplexed philosophers, and have driven them into diverse thoughts to find out the reasons of them. Some observing that the dividing of a body into little parts, maketh it less apt to descend, than when it is in greater; have believed the whole cause of lightness and rarity to be derived from division. As for example, they

finde that lead cut into little pieces, will not go down so fast in water, as when it is in bulk: and it may be reduced into so small atoms, that it will for some space swim upon the water like dust of wood.

Which assumption is proved by the great *Galileus*; unto whose exellent wit and admirable industry the world is beholding, not only for his wonderfull discoveries made in the heavens, but also for his accurate and learned declaring of those very things that lie under our feet. He, about the 90. Page of his first Dialogue of motion, doth clearly demonstrate how any real medium must of necessity resist more the descent of a little piece of lead, or any other weighty matter, than it would a greater piece: and the resistence will be greater and greater, as the pieces are lesser and lesser. So that as the pieces are made less, they will in the same medium sink the slower; and do seem to have acquired a new nature of lightness by the diminution: not onely of having less weight in them than they had; as half an ounce is less than a whole ounce: but also of having in themselves a less proportion of weight to their bulk than they had; as a pound of cork is in regard of its magnitude lighter than a pound of lead: so as they conclude, that the thing whose continued parts are the lesser, is in its owne nature the lighter and the rarer; and other things whose continued parts are greater, they be heavier and denser.

5. The former opinion rejected, and the ground of their errour discovered.

But this discourse reacheth not home: for by it the weight of any body being discovered by the proportion it hath to the medium in which it descendeth, it must ever suppose a body lighter than it self in which it may sink and go to the bottom. Now of that lighter body, I enquire, what maketh it be so; and you must answer by what you have concluded, that it is lighter than the other, because the parts of it are less, and more severed from one another: for if they be as close together, their division availeth them nothing, since things sticking fast together, do work as if they were but one, and so a pound of lead, though it be filed into small dust, if it be comptcted hard together, will sink as fast as if it were in one bulk.

Now then allowing the little parts to be separated, I ask, what other body filleth up the spaces between those little parts of the medium in which your heavy body descended? For if the

the parts of water are more severed than the parts of lead, there must be some other substance to keep the parts of it asunder: let us suppose this to be air: and I ask, whether an equal part of air be as heavie as so much water? or whether it be not? if you say, it is; then the compound of water and air must be as heavie as lead; seeing that their parts one with another are as much compacted as the parts of lead are. For there is no difference whether those bodies, whose little parts are compacted together, be of the same substance, or of divers, or whether the one be divided into smaller parts than the other, or no, (so they be of equal weights) in regard of making the whole equally heavie: as you may experience, if you mingle pin-dust with sand of equal weight, though it be beaten into far smaller divisions than the pin-dust, and put them in a bag together.

But if you say, that air is not so heavie as water; it must be, because every part of air hath again its parts more severed by some other body, than the parts of water are severed by air. And then I make the same instance of that body which severeth the parts of air. And so at the last (since there cannot actually be an infinite process of bodies one lighter than another) you must come to one, whose little parts filling the pores and spaces between the parts of the others, have no spaces in themselves to be filled up.

But assoon as you acknowledge such a body to be lighter and rarer than all the rest, you contradict and destroy all you said before. For by reason of its having no pores, it followeth by your rule, that the little parts of it must be as heavie, if not heavier than the little parts of the same bigness of that body whose pores it filleth; and consequently it is proved by the experience we alleged of pin-dust mingled with sand, that the little parts of it cannot by their mingling with the parts of the body in which it is immediately contained, make that lighter than it would be if these little parts were not mingled with it. Nor would both their parts mingled with the body which immediately containeth them, make that body lighter. And so proceeding on in the same sort through all the mingled bodies, till you come to the last, that is immediately mingled with water; you will make water nothing the lighter, for being mingled with all these; and by consequence it should be as heavie and as dense as lead.

Now that which deceived the authours of this opinion, was, that they had not a right intelligence of the causes which made little parts of bodies (naturally heavie) descend slowly, in regard of the velocity of greater parts of the same bodies descending: the doctrine of which we intend to deliver hereafter.

6. The opinion of those Philosophers related, who put rarity to consist in the mixtion of vacuity among bodies.

Others therefore perceiving this rule to fall short, have indeavoured to piece it out by the mixtion of vacuity among bodies; believing it is that which maketh one rarer than another. Which mixtion they do not put alwaies immediate to the main body they consider: but if it have other rarer and lighter bodies mingled with it, they conceive this mixtion immediate onely to the rarest, or lightest. As for example; a chrystal being lighter and consequently being rarer than a diamond, they will not say that there is more vacuity in a chrystal than in a diamond; but that the pores of a chrystal are greater, and that consequently there is more air in a chrystal to fill the pores of it, than is in a diamond; and the vacuities are in the air, which abounding in a chrystal, more than a diamond, maketh that lighter and rarer than this, by the more vacuities that are in the greater Quantity of air which is mingled with it.

But against this supposition, a powerfull adversary is urged: for *Aristotle*, in his 4. Book of physicks, hath demonstrated that there can be no motion in vacuity. It is true, they indeavour to evade his demonstration (as not reaching home to their supposition) by acknowledgeing it to be an evident one in such a vacuity as he there speaketh of; which he supposed to to be so great a one that a body may swim in it as in an ocean, and not touch or be near any other body: whereas this opinion excludeth all such vast inanitie, and admiteth no vacuities but so little ones as no body whatsoever can come unto but will be bigger than they; and consequently, must on some side or other touch the corporeal parts which those vacuities divide; for they are the separations of the least parts, that are, or can be, actually divided from one another: which parts must of necessitie touch one another on some side; or else they could not hang together to compose one substance; and therefore, the dividing vacuities, must be less than the divided parts. And thus, no body will ever be in danger of floating up and down without touching any thing: which is the difficulty that *Aristotle* chiefly impugneth.

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I confess I should be very glad that this supposition might serve our turn, and save the *Phenomena* that appear among bodies through their variety of Rarity and Density: which if it might be, then would I straight go on to the inquiring after what followed out of this ground, as Astronomers (to use our former similitude) do calculate the future appearances of the celestial bodies out of those motions and orbs they assign unto the heavens. For as the apprehension of vacuity in bodies is very easie and intelligible: so the other (which I conceive to be the truth of the case) is exceedingly abstracted, and one of the most difficult points in all the metaphysicks: and therefore I would (if it were possible) avoid touching upon it in this discourse, which I desire should be as plain and easie, and as much removed from scholastick terms, as may be. 7. The opinion of vacuities refuted.

But indeed, the inconveniences that follow out of this supposition of vacuities, are so great, as it is impossible by any means to slide them over. As for example; let us borrow of *Galileus* the proportion of weight between water and air. He sheweth us how the one is 400. times heavier than the other. And *Marinus Ghetaldus* teacheth us that gold is 19. times heavier than water: so that gold must be 7600 times heavier than air. Now then considering that nothing in a body can weigh, but the solid parts of it; it followeth, that the proportion of the parts of gold in a sphere of an inch diameter, is to the parts of air of a like dimension as 7600 is to one. Therefore in air it self the vacuities that are supposed in it, will be to the solid parts of it in the same proportion as 7600 to one. Indeed, the proportion of difference will be greater: for even in gold many vacuities must be admitted, as appeareth in the heating of it, which sheweth that in every the least part it is exceeding porous. But according to this rate, without pressing the inconvenience any further; the air will by this reckoning appear to be like a net, whose holes and distances, are to the lines and threads, in the proportion of 7600 to one; and so, would be lyable to have little parts of its body swim in those greater vacuities; contrary to what they strive to avoid, which would be exceedingly more, if we found on the one side any bodies heavier and denser than gold, and that were so solid as to exclude all vacuities, and on the other side should balance them with such bodies. Dialog. 1. del. *Movim.* p. 81. Archimed. Promor.

bodies as are lighter and rarer than air; as fire is, and as some will have the *æther* to be. But already the disproportion is so great, and the vacuity so strangely exceedeth the body in which it is, as were too great an absurdity to be admitted.

And besides, it would destroy all motion of small bodies in the air, if it be true (as *Aristotle* hath demonstrated in the fourth book of his physicks) that motion cannot be made but among bodies, and not *in vacuo*.

Again, if rarity were made by vacuity, rare bodies could not be gathered together, without losing their rarity and becoming dense. The contrary of which, we learn by constant experience; as when the smith and glass-mender drive their white and fury fires, (as they term them;) when air pierceth most in the sharp wind: and generally we see that more of the same kind of rare bodies, in less place, worketh most efficaciously according to the nature that resulteth out of that degree of rarity. Which argueth, that every little part is as rare as it was before (for else it would lose the virtue of working according to that nature;) but that by their being crowded together, they exclude all other bodies that before did mediate between the little parts of their main body; and so, more parts being gotten together in the same place than formerly there were, they work more forcibly.

Thirdly, if such vacuities were the cause of rarity, it would follow, that fluid bodies being rarer than solid ones, they would be of themselves standing, like nets or cobwebs: whereas contrariwise, we see their natures are to run together, and to fill up every little creek and corner: which effect, following out of the very nature of the things themselves, must needs exclude vacuities out of that nature.

And lastly, if it be true (as we have shewed in the last Chapter) that there are no actual parts in Quantity; it followeth of necessity, that all Quantity must of it self be one; as Metaphysicks teach us: and then, no distance can be admitted between one Quantity and another.

And truly, if I understand *Aristotle* right, he hath perfectly demonstrated that no vacuity is possible in nature; neither great nor little: and consequently, the whole machin raised upon that supposition, must be ruinous. His argument is to this purpose:

purpose: What is nothing, cannot have parts: but vacuum is nothing (because as the adversaries conceive it, vacuum is the want of a corporeal substance in an enclosing body, within whose sides nothing is, whereas a certain body might be contained within them, as if in a pail or bowl of a gallon, there were neither milk, nor water, nor air, nor any other body whatsoever) therefore, vacuum cannot have parts. Yet those who admit it do put it expresly for a space; which doth essentially include parts. And thus they put two contradictories, nothing and parts, that is, parts and no parts; or something and nothing; in the same proposition. And this, I conceive to be absolutely unavoidable.

8. Rarity and Density consist in the severall proportions, which Quantity hath to its substance.

For these reasons therefore, I must intreat my Readers favour, that he will allow me to touch upon metaphysicks a little more than I desire or intended: but it shall be no otherwise, than as is said of the dogs by the river *Nilus* side; who being thirsty, lap hastily of the water, onely to serve their necessity as they run along the shore. Thus then; remembring how we determined that Quantity is Divisibility: it followeth, that if besides Quantity there be a substance or thing which is divisible; that thing if it be conditinguished from its Quantity or Divisibility, must of it self be indivisible: or (to speak more properly) it must be, not divisible. Put then such substance to be capable of the Quantity of the whole world or universe; and consequently, you put it of it self indifferent to all, and to any part or Quantity: for in it, by reason of the negation of Divisibility, there is no variety of parts, whereof one should be the subject of one part of Quantity, or another of another; or that one should be a capacity of more, another of less.

This then being so, we have the ground of more or less proportion between substance and quantity: for if the whole quantity of the universe be put into it, the proportion of Quantity to the capacity of that substance, will be greater than if but half that Quantity were imbibed in the same substance. And because proportion changeth on both sides by the single change of only one side: it followeth, that in the latter, the proportion of that substance to its Quantity, is greater; and that in the former, it is less; howbeit the substance in it self be indivisible.

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What we have said thus in abstract, will sink more easily into us if we apply it to some particular bodies here among us, in which we see a difference of Rarity and Density; as to air, water, gold, or the like; and examine if the effects that happen to them, do follow out of this disproportion between substance and Quantity. For example, let us conceive that all the Quantity of the world were in one uniform substance, then the whole universe would be in one and the same degree of Rarity and Density: let that degree, be the degree of water; it will then follow, that in what part soever there happeneth to be a change from this degree, that part will not have that proportion of quantity to its substance, which the quantity of the whole world had to the presupposed uniform substance. But if it happeneth to have the degree of rarity which is in the air, it will then have more quantity in proportion to its substance, than would be due unto it according to the presupposed proportion of the quantity of the universe to the foresaid uniform substance; which in this case is as it were the standard to try all other proportions by. And contrariwise, if it happeneth to have the degree of Density which is found in the earth or in gold; then it will have less quantity in proportion to its substance, than would be due unto it according to the foresaid proporion, or common standard.

Now to poceed from hence, with examining the effects which result out of this compounding of Quantity with substance, we may first consider, that the definitions which *Aristotle* hath given us of Rarity and Density, are the same we drive at: he telleth us that that body is rare whose quantity is more, and its substance less; that, contrariwise dense, where the substance is more and the quantity less. Now if we look into the proprieties of the bodies we have named, or of any others, we shall see them all follow clearly out of these definitions. For first, that one is more diffused, another more compacted; such diffusion and compaction seem to be the very natures of Rarity and Density, supposing them to be such as we have defined them to be; seeing that substance is more diffused by having more parts, or by being in more parts; and is more compacted by the contrary. And then, that rare bodies are more divisible than dense ones, you see is coincident into the same conceit with their diffusion and compaction. And from hence again it follo-

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loweth, that they are more easily divided in great, and likewise, that they are by the force of natural Agents divisible into lesser parts: for both these (that is, facility of being divided, and easie divisibility into lesser parts) are contained in being more divisible, or in more enjoying the effect of quantity, which is divisibility. From this again followeth, that in rare bodies there is less resistance to the motion of another body through it, than in dense ones; and therefore a like force passeth more easily through the one, than through the other. Again, rare bodies are more penetrative and active than dense ones; because being (by their over proportion of quantity) easily divisible into smal parts, they can run into every little pore, and so incorporate themselves better into other bodies, than more dense ones can. Light bodies likewise must be rarer, because most divisible, if other circumstances concur equally.

Thus you see d cyphered unto your hand, the first division of bodies flowing from Quantity as it is ordained to substance for the composition of a body: for since the definition of a body is, *A thing which hath parts*; and quantity is that, *by which it hath parts*; and the first propriety of quantity is, *to be bigger* or *lesse*; and consequently the first differences of having parts, are to have bigger or lesse, more or fewer; what division of a body can be more simple, more plain, or more immediate, than to divide it by its *Quantity*, as making it have bigger or lesse, more or fewer parts in proportion to its substance?

Neither can I justly be blamed for touching thus on Metaphysicks, to explicate the nature of these two kinds of bodies; for Metaphysicks being the Science above Physicks, it belongeth unto her to declare the principles of Physicks: of which, these we have now in hand, are the very first step. But much more, if we consider that the composition of quantity with substance, is purely Metaphysical; we must necessarily allow the inquiry into the nature of Rarity and Density, to be wholly Metaphysical; seeing that the essence of Rarity and Density standeth in the proportion of quantity to substance; if we believe *Aristotle*, (the greatest Master that ever was, of finding out Definitions and Notions) and trust to the uncontroulable reasons we have brought in the precedent discourse.

9. This explication of Rarity and Density, by the composition of

All must admit in Physical bodies, a Metaphysical composition.

of substance with quantity, may peradventure give little satisfaction unto such as are not used to raise their thoughts above Physical and natural speculations; who are apt to conceive there is no other composition or resolution, but such as our senses shew us in compounding and dividing of bodies according to quantitative parts. Now this obligeth us to shew that such a kinde of composition and division as this must necessarily be allowed of, even in that course of doctrine which seems most contrary to ours. To which pupose, let us suppose that the position of *Democritus* or of *Epicurus* is true; to wit, that the original composition of all bodies, is out of very little ones of various figures; all of them indivisible, not Mathematically, but Physically: and that this infinite number of indivisibles, doth float in an immense ocean of *vacuum* or imaginary space. In this position, let any man who conceiveth their grounds may be maintained, explicate how one of these little bodies is moved. For taking two parts of *vacuum*, in which this body successively is; it is clear, that really, and not onely in my understanding, it is a difference in the said body to be now here now there: wherefore when the body is gone thither, the notion of being here is no more in the body; and consequently is divided from the body. And therefore when the body was here, there was a composition between the body and its being here; which seeing it cannot be betwixt two parts of Quantity, must of necessity be such a kinde of composition, as we put between quantity and substance. And certainly, let men wrack their brains never so much, they will never be able to shew how motion is made, without some such composition and division, upon what grounds soever they proceed.

And if then they tell us, that they understand not how there can be a divisibility between substance and quantity; we may reply, that to such a divisibility two things are required; first, that the notions of substance and quantity be different; secondly, that the one of them may be changed without the other. As for the first, it is most evident we make an absolute distinction between their two notions; both when we say that *Socrates* was bigger a man than a boy; and when we conceive that milk or water whiles it boileth, or wine whiles it worketh, so as they run over the vessels they are in, are greater, and

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poſſeſſ: more place than when they were cool and quiet, and filled not the veſſel to the brim. For howſoever witty explications may ſeem to evade, that the ſame thing is now greater now leſſer; yet it cannot be avoided, but that ordinary men who look not into Philoſophy, do both conceive it to be ſo, and in their familiar diſcourſe expreſſe it ſo; which they could not do, if they had not different notions of the ſubſtance, and of the quantity of the thing they ſpeak of. And though we had no ſuch evidences, the very names and definitions of them would put it beyond ſtrife: all men calling ſubſtance, a thing; quantity, bigneſs: and referring a thing to *Being*; as who would ſay, that which is: but bigneſs to ſome other of like nature, unto which it is compared; as, that it is half as big, twice as big, or the like.

This then being unavoidable, that the notions are diſtinguiſhed; there remaineth no difficulty but onely in the ſecond, namely that the one may be changed, and the other not. Which reaſon and demonſtration do convince, as we have ſhewed. Wherefore if any ſhall yet further reply, that they do not underſtand how ſuch change is made; we ſhall anſwer, by asking them whether they know how the change of being ſometimes here ſometimes there is made by local motion in *vacuum*, without a change in the body moved. Which queſtion if they cannot ſatisfie, they muſt either deny that there is any local motion in *vacuum*; or elſe admit a change in quantity without a change in ſubſtance; for this latter is as evidently true, as they ſuppoſe the former to be; though the manner how they are effected be alike obſcure in both, and the reaſon of the obſcurity the ſame in both.

With which we will conclude the preſent Chapter; adding onely this note: That if all Phyſical things and natural changes do proceed out of the conſtitution of rare and denſe bodies in this manner as we do put them, (as the work we have in hand intendeth to ſhew) then, ſo manifold effects will ſo convince the truth of this doctrine which we have declared, that there can remaine no doubt of it: neither can there be any of the diviſibility of quantity from ſubſtance; without which this doctrine cannot conſiſt. For it cannot be underſtood, how there is a greater proportion of quantity than of ſubſtance;

stance; or contrariwise, of substance than of quantity; if there be not real divisibility between quantity and substance. And much lesse can it be conceived, that the same thing hath at one time a greater proportion of quantity, and at another time a lesse, if the greater or lesser proportion be not separable from it; that is, if there be not a divisibility betwixt it and substance, as well as there are different notions of them. Which to prove by the proper principles belonging to this matter, would require us to make a greater inroad into the very bowels of Metaphysicks, and to take a larger circuit than is fitting either for the subject, or for the intended brevity of this Treatise.

CHAP. IV.

Of the four first qualities: and of the four Elements.

1. The notion of density and rarity have a latitude capable of infinite variety.

THe subject of our Discourse hitherto hath been three simple notions; Quantity, Rarity, and Density. Now it shall be to enquire if by compounding these with gravity or weight (which is one of the species of Quantity above mentioned, and of which I shall speak at large hereafter) we may beget any farther qualities, and so produce the four first bodies called Elements. In imitation of Logicians, who by compounding such Propositions as of themselves are evident to mans nature assoon as they are proposed, do bring forth new knowledges: which threds they still entermix and weave together, till they grow into a fair piece. And thus the Sciences they so much labour for, and that have so great an extent, do result out of a few and simple notions in their beginnings.

But before we fall to mingling and comparing them together, I think it will not be amisse to set down and determine what kinde of things we mean by rare, and what by dense; to the end that when the names are agreed upon, we may slip into no errour by mistaking them. So then, although there be several considerations, in regard of which, rarity and density may be differently attributed to bodies: yet because mans discerning them, to be able to discourse accordingly of them, is the principal respect for which their denominations are to be allotted them,

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we may with reason call those things dense, wherein a man findeth a sensible difficulty to part them; and those rare, where the resistance is imperceptible.

And unto these two notions of rarity and density, we must allow a great latitude, far from consisting in an indivisible state; for seeing that rarefaction maketh a lesser body equal to a bigger; and that all inequality betwixt two bodies, hath the conditions of a body; it followeth that the excesse of one body over an other, consisteth of infinite parts into which it might be divided: and consequently, that what is rarified, passeth as many degrees as the inequality or excesse hath parts. And the same law being in condensation, both dense and rare things must be acknowledged to be capable of infinite variety, and diversity of states in regard of more and lesse in the same kinde.

2. How moistnes and dryness are begotten in dense bodies.

These things being premised; and calling to minde that it is the nature of density to make the parts of a dense thing compact, and stick together, and be hardly divisible; and on the contrary side, that it is the nature of rarity, to diffuse and extend a rare thing, and to prepare and approach it to division, according to the proportion of the degree of rarity which it hath; and that weight doth abound where there is excesse of density, and is very little or none in excesse of rarity: we may now begin in our imagination to put these qualities into the scales one against another, to see what effects they produce in bodies. And first, let us weigh gravity against density or sticking together of parts: which sticking or compactednesse being natural to density, requireth some excesse of gravity in proportion to the density, or some other outward violence, to break it. If then in a dense body the gravity overcome the density, and do make the parts of it break asunder, it will draw them downwards towards the center that gravity tendeth unto, and will never let them rest till they come thither, unlesse some impediment meet them by the way and stop their journey: so that such a body will, as neer as possibly it can, lie in a perfect spherical figure in respect of the center; and the parts of it will be changed and altered, and thrust on any side that is the ready way thither; so that by the force of gravity working upon it, it will run as far as it meeteth with nothing to hinder it from

attaining this ſpherichal ſuperficies. Wherefore ſuch bodies, for the moſt part, have no ſettled outſide of their own; but do receive their figure and limits from ſuch lets as hinder them from attaining to that ſphericalneſs they aim at.

Now *Ariſtotle* (whoſe definitions, are in theſe matters generally received, as fully expreſſing the notions of mankinde) telleth us, and our own experience confirmeth it, that we uſe to call thoſe things *moiſt*, which run in ſuch ſort as we have here ſet down; and that we term thoſe things *dry*, which have a conſiſtence within themſelves; and which to injoy a determinate figure, do not require the ſtop or hinderance of another body to limit and circle them in: which will be the nature of thoſe that have a greater proportion of denſity in reſpect of their gravity.

And thus, out of the compariſon of denſity with weight, we have found two more qualities than we yet had met withall, namely wetneſs and dryneſs. For although a body be denſe, (which of its own nature, ſingly conſidered, would preſerve the continuity of its parts, as making the body hardly divifible, whereby it would be dry) yet if the gravity that worketh upon it, be in proportion greater than the denſity, it will ſever the parts of it, and make them run to the center, and ſo become fluid and moiſt: though not in the eminenteſt degree that may be of fluidity and moiſture; by reaſon that if the like overproportion of gravity happen in a rare body, it will there more powerfully work its effect, than it can in a denſe body; becauſe a rare body will more eaſily obey, and yield to the gravity that maſtereth it, than a denſe one will; and conſequently, will be more fluid and moiſt than it.

3. How moiſtneſs and dryneſs are begotten in rare bodies.

Now on the other ſide, in weighing rarity againſt gravity; if it happen that the rarity overcome the gravity, then the gravity will not change the figure of a body ſo proportioned, but what figure it hath from its proper natural cauſes, the ſame will ſtill remain with it: and conſequently, ſuch a body will have terms of its own, and will not require an ambient body to limit, and circle it in: which nature, we call dry.

But if the proportion of the gravity be the greater, and do overcome the rarity; then, by how much the rarity is greater, ſo much the more will the gravity force it, to apply it ſelf equally

ly and on all sides to the center: and such a body will the more easily receive its figure from another, and will be less able to consist of it self: which properties, we attribute to wetnesse or moisture. So that it appeareth how the qualities of wet and dry, which first we found in things that were dense, are also common to that nature of bodies, which we term rare.

And thus, by our first inquiry after what kinde of bodies do result out of the compounding of rarity and density with gravity, we discover four different sorts: some dense ones that are dry, and others likewise dense that are moist: then again, some rare ones that are likewise moist, and other rare ones that are dry.

4. Heat is a property of rare bodies, and cold of dense ones.

But we must not rest here: let us proceed a little farther, to search what other properties these four kindes of bodies will have; which we shall best discover, if we apply them severally to some other compounded body (of which Nature, are all those we converse with or see) and then consider the effects which these do work upon it. To begin with that, which we said is so excessively rare that gravity hath no power over it. If we look upon the multitude of little parts it may be divided into, whereof every one will subsist by it self (for we have already proved it dry) and then suppose them to be moved with force and strength against the body we apply them to: it must necessarily follow, that they will forcibly get into the porousness of it, and passe with violence between part and part, and of necessity separate the parts of that thing one from another; as a knife or wedge doth a solid substance, by having their thinnest parts presst into it: so that if in the compounded thing, some parts be more weighty, others more light, (as of necessity there must be) the heaviest will all fall lowest, the lightest will fly uppermost, and those which are of a mean nature between the two extremes, will remain in middle. In sum, by this action of an extreme rare body upon a compounded one, all the parts of one kinde that were in the compounded one, will be gathered into one place; and those of divers kindes into divers places: which is the notion whereby *Aristotle* hath expressed the nature of heat; and is an effect, which daily experience in burning and boiling, teacheth us to proceed from heat. And therefore we cannot doubt, but that such extreme rare bodies are as well hot as dry.

On the other side, if a dense thing be applyed to a compound, it will (because it is weighty) presse it together: and if that application be continued on all sides, so that no part of the body that is pressed can flee from the siege of the dense body that presseth it, it will form it into a narrower room, and keep in the parts of it, not permitting any of them to slip out. So that what things soever it findeth within its power to master, be they light or heavy, or of what contrary natures soever, it compresseth them as much as it can, and draweth them into a lesse compasse, and holdeth them strongly together, making them stick fast to one another. Which effect, *Aristotle* took for the proper notion of cold; and therefore gave for definition of the nature of it, *that it gathereth things of divers natures*: and experience sheweth us in freezing, and all great coolings, that this effect proceedeth from cold.

5. Of the two dense bodies, the lesse dense is more cold: but of the two rare ones, the lesse rare is lesse hot.

But if we examine which of the two sorts of dense bodies (the fluide or the consistent) is most efficacious in this operation; we shall finde, that the lesse dense one is more capable of being applyed round about the body it shall besiege; and therefore will stop closer every little hole of it, and will more easily send subtile parts into every little vein of it; and by consequence, shrink it up together, and coagulate, and constringe it more strongly, than a body can that is extremely dense; which by reason of its great density, and the stubbornesse of its parts, cannot so easily bend and plie them to work this effect. And therefore, a body that is moderately dense is colder then another that is so in excesse; seeing that cold is an active or working power, and that which is lesse dense doth excell in working.

On the contrary side, rare bodies being hot, because their subtile parts environing a compounded body will sink into the pores of it, and to their power separate its parts; it followeth, that those wherein the gravity overcometh the rarity, are lesse hot than such others as are in the extremity, and highest excesse of rarity: both, because the former are not able to pierce so little parts of the resisting dense body, as extreme rare ones are; and likewise, because they more easily take ply by the obstacle of the solid ones they meet with, than these do.

So

So that out of this discourse we gather, that of such bodies that differ precisely by the proportion of Rarity and Density; those which are extremely rare, are in the excess of heat, and are dry withall: that weighty rare bodies are extremely humide, and meanly hot: that fluide dense bodies are moist, though not in such excess as rare ones that are so; but are coldest of any: and lastly, that extreme dense bodies are less cold than fluid dense ones, and that they are dry.

6. The extreme dense body is more dry, than the extreme rare one.

But whether the extreme dense bodies be more or lesse dry than such as are extremely rare, remaineth yet to be decided. Which we shall easily do, if we but reflect that it is density which maketh a thing hard to be divided, and that rarity maketh it easie: for a facility to yield unto division, is nothing else but a pliableness in the thing that is to be divided, whereby it easily receiveth the figure, which the thing that divideth it doth cast it into. Now this pliableness belongeth more to rare than to dense things: and accordingly, we see fire bend more easily, by the concameration of an oven, than a stone can be reduced into due figure by hewing. And therefore, since dryness is a quality that maketh those bodies wherein it reigneth, to conserve themselves in their own figure and limits, and to resist the receiving of any from another body; it is manifest that those are driest, wherein these effects are most seen; which is, in dense bodies: and consequently, excesse of dryness must be allotted unto them, to keep company with their moderate coldness.

7. There are but four simple bodies: and these are rightly named Elements

Thus we see that the number of Elements assigned by *Aristotle* is truly and exactly determined by him; and that there can qe neither more nor lesse of them; and that their qualities are rightly allotted to them: which to settle more firmly in our minds, it will not be misse-spent time to summe up in short the effects of what we have hitherto said to bring us unto this conclusion. First, we shewed that a body is made, and constituted a body by quantity. Next, that the first division of bodies is into rare and dense ones; as differing onely by having more and less quantity. And lastly, that the conjunction of gravity with these two, breedeth two other sorts of combinations: each of which is also twofold; the first sort, concerning rarity; out of which ariseth one extremely hot and moderately dry, and an-

other extremely humid and moderately hot: the second sort, concerning density; out of which, is produced one that is extremely cold and moderately wet, and another extremely dry and moderately cold. And these are the combinations whereby are constituted fire, air, water, and earth.

So that we have thus, the proper notions of the four Elements; and have both them and their qualities driven up and resolved into their most simple principles: which are, the notions of *Quantity*, and of the two most simple differences of quantitative things, *Rarity* and *Density*. Beyond which, mans wit cannot penetrate; nor can his wishes aim at more in this particular: seeing he hath attained to the knowledge of what they are, and of what maketh them be so, and that it is impossible they should be otherwise: and this, by the most simple and first principles, which enter into the composition of their nature. Out of which it is evident, that these four bodies are *Elements:* since they cannot be resolved into any others, by way of Physical composition; themselves being constituted by the most simple differences of a body. And again, all other bodies whatsoever must of necessity be resolved into them, for the same reason; because no bodies can be exempt from the first differences of a body. Since then, we mean by the name of an *Element*, *a body not composed of any former bodies, and of which all other bodies are composed*, we may rest satisfied that these are rightly so named.

8. The Author doth not determine whether every element doth comprehend under its name one only lowest species, or many: nor whether any of them be found pure.

But whether every one of these four Elements, do comprehend under its name one onely loweſt ſpecies or many (as, whether there be one onely ſpecies of fire, or ſeveral; and the like of the reſt) we intend not here to determine. Yet we note, that there is a great latitude in every kinde; ſeeing that, Rarity and Denſity (as we have ſaid before) are as diviſible as quantity. Which latitudes, in the bodies we converſe withall, are ſo limited, that what maketh it ſelf and other things be ſeen (as being accompanied by light) is called fire. What admitteth the illuminative action of fire, and is not ſeen, is called air. What admitteth the ſame action, and is ſeen (in the rank of Elements) is called water. And what through the denſity of it admitteth not that action, but abſolutely reflecteth it, is called earth.

And

And out of all we said of these four Elements, it is manifest there cannot be a fifth: as is to be seen at large in every Aristotelian Philosopher that writeth of this matter. I am not ignorant that there are sundry objections used to be made, both against these notions of the first qualities, and against the division of the Elements: but because they, and their solutions, are to be found, in every ordinary Philosopher; and that they be not of any great difficulty; and that the handling them, is too particular for the design of this discourse, and would make it too prolix; I refer the Reader to seek them, for his satisfaction, in those Authors that treat Physicks professedly, and have delivered a compleat body of Philosophy.

And I will end this Chapter with advertising him (lest I should be misunderstood) that though my disquisition here hath pitched upon the four bodies of fire, air, water, and earth; yet it is not my intention to affirm, that those which we ordinary call so, and do fall daily within our use, are such as I have here expressed them: or that these Philosophical ones (which arise purely out of the combination of the first qualities) have their residence or consistence in great bulks, in any places of the world, be they never so remote: as fire, in the hollow of the Moons orb; water, in the bottom of the sea; air, above the clouds; and earth below the mines. But these notions are onely to serve for certain Ideas of Elements; by which, the four named bodies, and the compounds of them, may be tryed and receive their doom of more or less: pure and approaching to nature from whence they have their denomination. And yet I will not deny, but that such perfect Elements may be found in some very little quantities, in mixed bodies: and the greatest abundance of them, in these four known bodies that we call in ordinary practice, by the names of the pure ones: for they are least compounded, and approach most to the simpleness of the Elements. But to determine absolutely their existence, or not existence, either in bulk or in little parts, dependeth of the manner of action among bodies: which as yet we have not meddled with.

CHAP. V.

Of the operations of the Elements in general; And of their activities compared with one another.

1. The first operation of the Elements is division, out of which resulteth local motion.

HAving by our former discourse inquired out what degrees and proportions of rarity and density compounded with gravity, are necessary for the production of the Elements, and first qualities, whose combinations, frame the Elements: our next consideration in that orderly progresse we have proposed unto our selves in this treatise (wherein our aim is, to follow successively the steps, which Nature hath printed out unto us) will be to examine the operations of the Elements, by which they work upon one another. To which end, let us propose to our selves a rare and a dense body encountring one another by the impulse of some exterior agent. In this case, it is evident, that since rarity implyeth a greater proportion of quantity, and quantity is nothing but divisibility, rare bodies must needs be more divisible than dense ones: & consequently, when two such bodies are pressed one against another; the rare body not being able to resist division so strongly, as the dense one is; and being not permitted to retire back, by reason of the extern violence impelling it against the dense body; it followeth, that the parts of the rare body must be severed, to let the dense one come between them: and so the rare body becometh divided, and the dense body the divider. And by this we see that the notions of divider and divisible do immediately follow rare and dense bodies; and do so much the more properly agree unto them, as they exceed in the qualities of Rarity and Density.

Likewise, we are to observe in our case, that the dense or dividing body must necessarily cut and enter farther and farther into the rare or divided body; and so the sides of it be joyned successively to new and new parts of the rare body that giveth way unto it, and forsake others it parteth from. Now the rare body being in a determinate situation of the universe, (which we call *being in a place*, and is a necessary condition belonging to all particular bodies) and the dense body coming to be within the rare body, whereas formerly it was not so: it followeth, that it loseth the place it had, and gaineth another. This effect, is that which we call local motion.

And

And thus we see, by explicating the manner of this action, that local motion is nothing else but the change of that respect or relation, which the body moved hath to the rest of the universe, following out of Division: and the name of local motion, formally signifieth onely the mutation of a respect to other extrinsecal bodies, subsequent to that division. And this is so evident and agreeable to the notions that all mankinde (who, as we have said, is judge and master of Language) naturally frameth of place, as I wonder much why any will labour to give other artificial and intricate doctrine of this that in it self is so plain and clear. What need is there to introduce an imaginary space (or with *Joannes Grammaticus*, a subsistent quantity) that must run through all the World; and then entail to every body an aiery entity, and unconceivable mood, an unintelligible Ubi, that by an intrinsecal relation to such a part of the imaginary space, must thereunto pin and fasten the body it is in? It must needs be a ruinous Philosophy that is grounded upon such a contradiction, as is the allotting of parts unto that, which the Authors themselves (upon the matter) acknowledge to be meerly nothing; and upon so weak a shift (to deliver them from the inconveniencies that in their course of doctrine other circumstances bring them unto) as is the voluntary creating of new imaginary Entities in things, without any ground in nature for them. Learned men should expresse the advantage and subtility of their wits, by penetrating farther into nature, than the vulgar; not by vexing and wresting it from its own course. They should refine and carry higher, not contradict and destroy the notions of mankinde, in those things that it is the competent judge of: as it undoubtedly is of those primary notions which *Aristotle* hath ranked under ten heads: which (as we have touched before) every body can conceive in grosse: and the work of Scholars is to explicate them in particular; and not to make the vulgar believe they are mistaken, in framing those apprehensions that nature taught them.

3. What place is; both notionally and really.

Out of that which hath been hitherto resolved it is manifest, that place really, and abstracting from the operation of the understanding, is nothing else but the inward superficies of a body that compasseth and immediately containeth another. Which ordina-

ordinarily being of a rare body that doth not shew it self unto us (namely, the air) is for the most part unknown by us. But because nothing can make impression upon our mind, and cause us to give it a name otherwise than by being known: therefore our understanding to make a compleat notion, must add something else to this fleeting and unremarkable superficies that may bring it unto our acquaintance. And for this end we may consider farther, that as this superficies hath in it self, so the body enclosed in it gaineth a certain determinate respect unto the stable and immovable bodies that environ it. As for example, we understand such a tree to be in such a place by having such and such respects to such a hill neer it, or to such a house that standeth by it, or to such a river that runneth under it, or to such an immovable point of the heaven that from the Suns rising in the Equinox is called East, and such like. To which purpose, it importeth not whether these that we call immovable bodies and points be truly so, or do but seem so to mankind. For man talking of things according to the notions he frameth of them in his minde (speech being nothing else but an expression to an other man, of the images he hath within himself) and his notions being made according to the seeming of the things, he must needs make the same notions, whether the things be truly so in themselves, or but seem to be so, when that seeming or appearance is alwaies constantly the same.

3. Local motion is that division whereby a body changeth its place.

Now then when one body dividing another getteth a new immediate clothing; and consequently new respects to the stable and immovable bodies (or seeming such) that environ it; we do vary in our selves the notion we first had of that thing; conceiving it now accompanied with other circumstances and other respects than formerly it had. Which notion we expresse by saying, it hath changed its place, and is now no longer where it was at the first. And this change of place we call *Local motion:* to wit, the departing of a body from that hollow superficies which inclosed it; and its changing unto another, whereby it gaineth new respects to those parts of the world that have, or in some sort may seem to have immobility and fixed stableness. So as hence it is evident, that the substance of local motion consisteth in division; and that the alteration of Locality followeth division; in such sort as becoming like or unlike of one wall

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to another, followeth the action whereby one of them becometh white.

And therefore in nature we are not to ſeek for any entity or ſpecial cauſe of applying the moved body to a place as place, (which is but a reſpect conſequent to the effect of diviſion) but onely to conſider what real and Phyſical action uniteth it to that other body, which is called its place, and truly ſerveth for that effect. And conſequently, they who think they have diſcovered a notable ſubtilty by bringing in an Entity to unite a body to its place, have ſtrained beyond their ſtrength, and have graſped but a ſhadow; which will appear yet more evident, if they but mark well how nothing is diviſible but what of it ſelf (abſtracting from diviſion) is one. For the nature of diviſion is *the making of many*; which implyeth, that what is to be divided muſt of neceſſity be not *many* before it be divided. Now quantity being the ſubject of diviſion, it is evident that purely of it ſelf and without any force or adjoyned helps, it muſt needs be one, whereſoever ſome outward agent doth not introduce multiplicity upon it. And whenſoever other things work upon quantity as quantity, it is not the nature and power of their operation to produce unity in it and make it one; for it is already one: but contrariwiſe, the immediate neceſſary effect that floweth from them in this caſe, is to make one quantity many, according to the circumſtances that accompany the divider, and that which is to be divided. And therefore, although we may ſeek cauſes why ſome one thing ſticketh faſter together than ſome other, yet to ask abſolutely why a body ſticketh together, were prejudicial to the nature of quantity; whoſe eſſence is to have parts ſticking together, or rather to have ſuch unity, as without it all diviſibility muſt be excluded.

4. The nature of quantity of it ſelf is ſufficient to unite a body to its place.

Out of which diſcourſe it followeth, that in local motion we are to look onely for a cauſe or power to divide, but not for any to unite. For the very nature of quantity uniteth any two parts that are indiſtant from one another, without needing any other cement to glew them together: as we ſee the parts of water and all liquid ſubſtances, do preſently unite themſelves to other parts of like bodies when they meet with them, and to ſolid bodies if they chance to be next unto them. And therefore it is vain to trouble our heads with Unions and imagina-

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ry Moods to unite a body to the place it is in, when their own nature maketh them one as soon as they are immediate to each other. And accordingly, if when we see a boul move, we would examine the causes of that motion, we must consider the quantity of air or water it maketh to break from the parts next unto it, to give place unto it self: and not speculate upon an intrinseal relation from the body to a certain part of the imaginary space they will have to run through all things. And by ballancing that quantity of air or water which it divideth, we may arrive to make an estimate of what force the boul needeth to have for its motion.

5. All operations among bodies, are either local motion, or such as follow out of local motion.

Thus having declared that the locality of motion is but an extrinseal denomination, and no reality in the thing moved; we may now cast an eye upon a vast consequence that may be deduced out of what we have hitherto said. For if we consider the nature of a body, that is, that a body is a body by quantity; and that the formal notion of quantity is nothing else but divisibility; and that the adequate act of divisibility is division: it is evident there can be no other operation upon quantity, nor (by consequence) among bodies, but must either be such division as we have here explicated, or what must necessarily follow out of such division. And division (as we have even now explicated) being local motion; it is evident that all operations among bodies are either local motion, or such as follow out of local motion. Which conclusion, howsoever unexpected, and may at the first hearing appear a Paradox, will nevertheless by the ensuing work receive such evidence as it cannot be doubted of; and that not onely by force of argumentation and by necessity of notions (as is already deduced) but also by experience, and by declaration of particulars as they shall occurre.

6. Earth compared to water in activity.

But now to apply what we have said to our proposed subject: it is obvious to every man, that seeing the divider is the agent in division and in local motion; and that dense bodies are by their nature dividers; the earth must in that regard be the most active among the Elements, since it is the most dense of them all. But this seemeth to be against the common judgement of all the searchers of nature, who unanimously agree that fire is the most active Element. As also it seemeth to impugn what we

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our selves have determined, when we said, there were two active qualities, heat and cold, whereof the first was in its greatest excesse in fire, and the latter in water.

To reconcile these, we are to consider that the action of cold in its greatest height is composed of two parts; the one is a kinde of pressing, and the other is penetration, which requireth applicability. Of which two the former ariseth out of density, but the latter out of moderation of density, as I have declared in the precedent Chapter. Wherefore the former will exceed more in earth, though the whole be more eminent in water. For though considering onely the force of moving (which is a more simple and abstracted notion, than the determination and particularization of the Elements, and is precedent to it) therein earth hath a precedency over water: yet taking the action as it is determined to be the action of a particular Element, and as it concurreth to the composition or dissolution of mixed bodies; in that consideration (which is the chief work of Elements, and requireth an intime application of the Agents) water hath the principality and excesse over earth. §. 6.

As for fire it is more active than either of them; as it will appear clearly if we consider, how when fire is applyed to fewell, and the violence of blowing is added to its own motion, it incorporateth it self with the fewell, and in a small time converteth a great part of it into its own nature, and shattereth the rest into smoak and ashes. All which proceedeth from the exceeding smallnesse and drynesse of the parts of fire; which being moved with violence against the fewell, and thronging in multitudes upon it; they easily pierce the porous substance of it, like so many extreme sharp needles. 7. The manner whereby fire getteth into fewel, proveth that it exceedeth earth in activity.

And that the force of fire is as great and greater than of earth, we may gather out of our former discourse; where having resolved that density is the virtue by which a body is moved and doth cut the *medium*; and again considering that celerity of motion, is a kinde of density, (as we shall by and by declare) it is evident, that since blowing must of necessity presse violently and with a rapid motion, the parts of fire against the fewel, and so condense them exceedingly there, (both by their celerity, and by bringing very many parts together there;) it must needs

needs also give them activity and virtue to pierce the body they are beaten against.

Now, that celerity is a kinde of density, will appear by comparing their natures. For if we consider that a dense body may be dilated so as to possesse and fill the place of a rare body that exceeded it in bignesse; and by that dilatation, may be divided into as many and as great parts as the rare body was divisible into; we may conceive that the substance of those parts, was by a secret power of nature folded up in that little extension in which it was before. And even so, if we reflect upon two Rivers of equal channels and depths, whereof the one goeth swifter than the other; and determine a certain length of each channel, and a common measure of time: we shall see that in the same measure of time, there passeth a greater bulk of water in the designed part of the channel of the swifter stream, than in the designed part of the slower, though those parts be equal.

Neither doth it import, that in velocity we take a part of time, whereas in density it seemeth that an instant is sufficient; and consequently, there would be no proportion between them. For knowing Philosophers do all agree that there are no instants in time, and that the apprehension of them proceedeth meerly from the manner of our understanding. And as for parts in time, there cannot be assumed any so little, in which the comparison is not true: and so in this regard, it is absolutely good.

And if the Reader have difficulty at the disparity of the things which are pressed together in density and in celerity; for that in density there is onely substance, and in celerity there is also quantity, crowded up with the substance; he will soon receive satisfaction, when he shall consider that this disparity is to the advantage of what we say, and maketh the nature of density more perfect in celerity, and consequently more powerfull in fire than in earth. Besides, if there were no disparity, it would not be a distinct species of density, but the very same.

8. The same is proved by the manner, whereby fire cometh out of fewel and worketh upon other bodies.

By what we have spoken above, it appeareth how fire getteth into fewel; now let us consider how it commeth out: for the activity of that fierce body will not let it lie still and rest, as long as it hath so many enemies round about it to rouse it up. We see then that as soon as it hath incorporated it self with the fewel,

fewel and is grown master of it by introducing into it so many of its own parts, (like so many Souldiers, into an Enemies Town) they break out again on every side with as much violence as they came in. For by reason of the former resistance of the fewel; their continual streaming of new parts upon it, and one overtaking another there where their journey was stopped, (all which is encreased by the blowing) doth so exceedingly condense them into a narrower room than their nature affecteth, that as soon as they get liberty, and grow masters of the fewel, (which at the first was their prison) they enlarge their place, and consequently come out and flie abroad; ever aiming right forwards from the point where they begin their journey: for the violence wherewith they seek to extend themselves into a larger room, when they have liberty to do so, will admit no motion but the shortest, which is, by a straight line.

So that if in our phantasie, we frame an Image of a round body all of fire; we must withall presently conceive, that the flame proceeding from it, would diffuse it self every way indifferently in straight lines; in such sort, that the source serving for the center, there would be round about it an huge sphear of fire and of light; unless some accidental and extern cause should determine its motion more to one part than to another. Which compasse, because it is round, and hath the figure of a sphear, is by Philosophers termed the sphear of its activity.

So that it is evident, that the most simple and primary motion of fire, is a flux in a direct line from the center of it, to its circumference, taking the fewel for its center: as also, that when, it is beaten against a harder body, it may be able to destroy it, although that body be in its own nature more dense than fire. For the body against which is presseth, either hath pores, or hath none, (as, the Elements have none:) if it hath pores; then the fire, by reason of the violent motion of the impellent, driveth out the little bodies which fill up those pores, and succeeding in their room, and being multiplyed there, causeth those effects which in our discourse of the Elements we assigned to heat. But if it have no pores; it will be either rare or dense: if it be rare; then, in cause that the force of the impellent be

greater

greater than the resistance of the rare body, it will force the fire to divide the rare body. But if it be dense; as, some atom of earth; then, though at the first it cannot divide it; yet by length of time and by continual beating upon it, it may come to wear off some part of it, the force of the impellent by little and little bending the atom of the earth, by driving a continual stream of a lesser part of fire, against some determinate part of the atom. By which word *Atom*, no body will imagine we intend to express a perfect indivisible, but onely, the least sort of natural bodies.

CHAP. VI.

Of Light: what it is.

1. In what sense the Author rejecteth qualities.

HAving said thus much of the fire; the neer relation that is between it and light, inviteth us in the next place to bend our eyes to that which useth to dazel theirs who look unwarily upon it. Certainly, as among all the sensible qualities, it is the principal; so among all corporeal things, it seemeth to aim rightest at a spiritual nature, and to come nerest unto it. And by some hath been judged to be spiritual; if our eyes be capable to see spirits. No meaner man than *Aristotle* leadeth the dance to hold light a quality, and mainly to deny it any bodily subsistence. And there hath followed him no fewer, than almost all the world ever since. And the Question importeth no less, than the whole doctrine of qualities; for admit light to be a body, and hardly any man will hold up his hand in defence of any other quality: but if it be a quality; then all others come in by parity and for company.

But before we go any farther, it will not be amisse to expresse what we mean when we reject qualities; and how, in some sense, we are content to admit them. According to that description that Philosophers ordinarily do make of them, (and especially the modern) we can by no means give way unto them. I confesse ingenuously, I understand not what they mean by them; and I am confident, that neither do they. For the very notion, that their first words seem to expresse of them, they contradict again, before they make an end of describing what they are. They will have them to be real

Entities

Entities or *Things*, distinct from the bodies they accompany: and yet, they deny them a subsistence or self-being; saying they do but inhere in their subject, which supporteth them; or which is all one, that their being is a dependence of a subject.

If they will reflect upon what they say, and make their thoughts and their words agree; they will finde, that the first part of their description maketh them compleat substances; which afterwards, in words they flatly deny: and it is impossible to reconcile these two meanings. A real Entity or thing must necessarily have an *Existence* or *Being* of its own: which they allow them. And whatsoever hath so, becommeth a substance: for it subsisteth by its own Existence; or (to say plainer) is what it is by its own Being; and needeth not the existence of another thing to give it a *Being*. And then presently to say that it doth not subsist of it self; or that it requireth the subsistence of a substance, to make it *Be*; is a pure contradiction to the former.

This ariseth from a wrong notion they make to themselves of substance, existence and subsistence: and from their not consulting sufficiently with their own thoughts, as well as studying in books. They meet there with different terms; by help of which, they keep themselves from contradiction in words, but not in effect. If the terms were rightly conceived, and notions duly fitted to them, (which requireth deep meditation upon the things themselves, and a brain free from all inclination to siding, or affection to opinions for the Authours sakes, before they be well understood and examined) many of those disputes would fall to the ground, in which oftentimes both sides lose themselves, and the question, before they come to an end. They are in the dark before they are aware: and then they make a noise, onely with terms; which like too heavy weapons that they cannot wield, do carry their strokes beyond their aim. Of such nature are the qualites and moods, that some modern Philosophers have so subtilised upon. And in that sense, we utterly deny them: which being a question appertaining to Metaphysicks, it belongeth not to our present purpose to engage our selves farther in it.

But, as they are ordinarily understood in common conver- 2.

In what sense the Author doth admit of qualities.

sation, we allow them. And our work is but to explicate and shew the particulars in retail, of what men naturally speak in grosse. For that serveth their turn to know what one another meaneth: whereas, it belongeth onely unto a Philosopher, to examine the causes of things. Others are content with the effects: and they speak truly and properly when they design them. As for example, when they say that Fire burneth by a quality of heat that it hath, or that a Dye is square by the quality of a cubical figure that is in it; they speak as they should do. But if others will take occasion upon this, to let their understanding give a *Being* unto these qualities, distinct from the substances in which they conceive them; there they misse. If we consider the same man hungry, or thirsty, or weary, or sleepy, or standing, or sitting; the understanding presently maketh within it self reall things of sleep, hunger, thirst, wearinesse, standing, and sitting. Whereas indeed, they are but different affections or situations of the same body. And therefore we must beware of applying these notions of our minde, to the things as they are in themselves: as much as we must, of conceiving those parts to be actually in a continued quantity, whereof we can frame actually distinct notions in our understanding. But at, when ordinary men say, that a yard containeth three feet; it is true in this sense, that three feet may be made of it; but that whiles it is a yard, it is but one quantity or thing, and not three things: so, they who make profession to examine rigorously the meaning of words, must explicate in what sense it is true that heat and figure (our former examples) are qualities: for such we grant them to be; and in no wise do contradict the common manner of speech; which entereth not into the Philosophical nature of them.

We see then, that qualities are nothing else but the proprieties, or particularities wherein one thing differeth from another. And therefore Logicians call substantial differences, substantial qualities: and say, they are predicated in *Quale quid*. But the Predicament of *Quality* is ordered by *Aristotle*, to conclude in it those differences of things, which are neither substantial nor quantitative, and yet are intrinsecal and absolute. And so that which the understanding calleth heat, and maketh a notion

notion of, distinct from the notion of the fire from whence it issueth to burn the wood that is neer it; is nothing else, in the fire, but the very substance of it in such a degree of rarity; or a continual stream of parts issuing out of the main stock of the same fire, that entreth into the wood, and by the rarity of it maketh its way through every little part, and divideth them. All which actions are comprised by the understanding under one notion of burning: and the power, (which is fire it self) to do these actions, under one notion of the quality of heat: though burning in effect, and explicated Philosophically, be nothing else but the continuance of those material motions we have even now described. In like manner, the cubical figure of a dye, is nothing else but the very body of the dye it self, limited by other bodies from being extended beyond those dimensions it hath: and so the quality of figure or squareness, which in common speech is said to be in it, is truly, the substance it self, under such a consideration as is expressed by that word.

3. Five arguments proposed to prove that light is not a body.

But to come to our question, upon the decision of which dependeth the fate of all the fictitious Entities which in the Schools are termed qualities. The chief motives that perswade light to be one of those, may, to my best remembrance, be reduced to five several heads. The first is, that it illuminateth the air in an instant, and therefore cannot be a body: for a body requireth succession of time to move in: whereas, this seemeth to spread it self over the whole Hemisphear in an instant; for as farre as the Sunne is distant from us, he no sooner raiseth his head above our Horizon, but his darts are in our face: and generally, no imagination can be framed, of any motion it hath in its dilatation.

The next is; that whereas no body can admit another into its place, without being removed away it self, to leave that room unto the advenient one; nevertheless, plain experience sheweth us daily, that two lights may be in the same place; and the first is so farre from going away at the comming of the second, that the bringing in of a second candle, and setting it neer the first, encreaseth the light in the room; which diminisheth again when the second is removed away. And by the same reason, if light were a body, it should drive away the aire

(which is likewise a body) wheresoever it is admitted: for within the whole sphear of the irradiation of it, there is no point wherein one may set their eye, but light is found. And therefore, if it were a body, there would be no room for air in that place which light taketh up. And likewise, we see, that it penetrateth all solid bodies, (and particularly glass,) as experience sheweth, in wood, stone, metals, and any other body whatsoever, if it be made thin enough.

The third argument, why light cannot be a body, is, that if it were so, it can be none other but fire, which is the subtilest, and most rarified of all bodies whatsoever. But if it be fire, then it cannot be without heat: and consequently, a man could not feel cold in a sun shining day. The contrary of which is apparent all winter long; whose brightest daies oftentimes prove the coldest. And *Galileus* with divers others since, did use from the sun to gather light in a kinde of stone that is found in *Italy* (which is therefore by them called, *la calamita delta luce*) and yet no heat appeared in it. A glow-worm will give light to read by, but not to warm you any whit at all. And it is said, that Diamonds and Carbuncles will shine like fire in the greatest darks; yet no man ever complained of being served by them as the foolish Satyre was by kissing of a burning coal. On the contrary side; if one consider how great heats may be made without any light at all, how can one be perswaded that light and heat should be the same thing, or indeed any whit of kin?

The fourth motive to induce us to believe that light cannot be a body, is the sudden extinction of it, when any solid body cometh between the fountain of it, and the place where he sendeth his beams. What becometh of that great expansion of light that shined all about, when a cloud interposeth it self between the body of the sun and the streams that come from it? Or when it leaveth our horizon to light the other world? His head is no sooner out of our sight; but at the instant all his beams are vanished. If that which filleth so vast a room were a body, something would become of it: it would at least be changed to some other substance; and some reliques would be left of it; as when ashes remain of burned bodies: for nature admitteth not the annihilation of any thing.

And in the last place; we may conceive that if light were a body,

dy, it would be shaken by the winds, and by the motion of the air; and we should see it quaver in all blustering weather. Therefore summing up all we have said; it seemeth most improbable, and indeed wholly impossible; that light should be a body; and consequently, must have his place among qualities.

But on the other side; before we apply our selves to answer these objections, let us make a short survey of those inducements that prevaile with us to believe light a body, notwithstanding so forcible oppositions. I admit so far of the third argument, as to allow light to be fire: for indeed it cannot be imagined to be any thing else; all properties agreeing so fully between them. But withall I must add; that it is not fire in every form, or fire joyned with every substance, that expresseth it self by light; but it is fire extremely dilated, and without mixture of any other gross body. Let me hold a peice of Linen or paper close by the flame of a candle, and by little and little, remove it farther and farther off; and methinks my very eyes tell me, that there is upon the paper some part of that which I see in the candle; and that it groweth still less and less like as I remove the paper farther from it: so that, if I would believe my sense, I should believe it as very a body upon the paper, as in the candle; though enfeebled, by the laxity of the channel in which it floweth.

4. The two first reasons to prove light to be a body, are, the resemblance it hath with fire: and because if it were a quality, it would alwaies produce an equal to it self.

And this seemeth to be strengthened, by the consideration of the adversaries position: for if it were a quality; then, seeing it hath no contrary to destroy or stop it, it should still produce an equal to it self, without end or growing feeble, whersoever it meeteth with a subject capable to entertain it, as air is.

The better to apprehend how much this faint resemblance of flame upon the paper, maketh for our purpose; let us turn the leaf, and imagine in our thoughts, after what fashion that fire which is in the flame of a little candle, would appear unto us, if it were dilated and stretched out to the utmost extent that excess of rarity can bring it unto. Suppose that so much flame, as would fill a cone of two inches height and half an inch diameter should suffer so great an expansion as to replenish with his light body a large chamber: and then, what can we imagine it would seem to be? How would the continual

5. The third reason; because if we imagine to our selves the substance of fire to be rarified, it will have the same appearances which light hath.

tinual driving it into a thinner substance, as it streameth in a perpetual flood from the flame, seem to play upon the paper? And then judge whether it be likely to be a body or no, when our discourse suggesteth unto us, that if it be a body, those very appearances must follow, which our eyes give us evidence are so in effect. If gold beaten into so airy a thinness as we see gilders use, doth remain still gold notwithstanding the wonderfull expansion of it: why shall we not allow, that fire dilated to his utmost period, shall still remain fire; though extremely rarified beyond what it was?

6. The fourth reason, from the manner of the generation and corruption of light, which agreeth with fire.

We know that fire is the rarest and the subtileſt substance that nature hath made among bodies; and we know likewise, that it is ingendred by the destroying and feeding upon some other more gross body: let us then calculate, when the oyl or tallow, or wax of a candle, or the bulk of a faggot or billet, is dilated and rarified to the degree of fire, how vast a place must it take up?

To this let us add what *Aristotle* teacheth us; that fire is not like a standing pool, which continueth full with the same water; and as it hath no waste, so it hath no supply: but it is a fluent and brook-like current. Which also we may learn, out of the perpetual nutriment it requireth: for a new part of fewel, being converted into a new part of fire (as we may observe, in the little attoms of oyl, or melted wax, that continually ascend apace up the week of a burning candle or lamp) of necessity the former must be gone to make room for the latter; and so, a new part of the rivel is continually flowing.

Now then, this perpetual flux of fire, being made of a gross body that so rarified will take up such a vast rom; if it die not at the instant of its birth, but have some time to subsist (be it never so short,) it must needs run some distance from the fountain whence it springeth. Which if it do, you need not wonder, that there should be so great an extent of fire as is requisite to fill all that space which light repleniſheth; nor that it should be still supplied with new, as fast as the cold of the air killeth it: for considering that flame is a much grosser substance than pure fire, (by reason of the mixture with it, of that viscous oily matter, which being drawn out of the wood and candle, serveth for fewel to the fire, and is by little and little converted

converted into it;) and withall reflecting upon the nature and motion of fire, (which is, to dilate it self extremely, and to fly all about from the center to the circumference;) you cannot choose but conceive, that the pure fire strugling to break away from the oily fewel (which is still turning into new fire) doth at length free his wings from that birdlime, and then flieth abroad with extreme swiftness, and swelleth and dilateth it self to a huge bulk, now that it hath gotten liberty; and so filleth a vast room; but remaineth still fire till it die: which it no sooner doth, but it is still supplied with new streames of it that are continually strained, and as it were squeesed out of the thick flame, which did imprison it, and kept it within it, till growing fuller of fire than it could contain (by reason of the continual attenuating the oily parts of it, and converting them into fire) it giveth libertie to those parts of fire, that are next the superficies, to fly whither their nature will carry them.

And thus, discourse would inform a blind man (after he hath well reflected on the nature of fire) how it must needs fill a mighty extent of place; though it have but a narrow beginning at the spring-head of it: and that there, by reason of the condensation of it, and mixture with a grosser body, it must needs burn other bodies; but that when it is freed from such mixture, and suffereth an extreme expansion, it cannot have force to burn, but may have means to express it self to be there present by some operation of it upon some body that is refined and subtilized enough to perceive it. And this operation a seeing man will tell you is done upon his eyes, (whose fitness to receive impression from so subtle an agent, Anatomists will teach you.) And I remember, how a blind school-master that I kept in my house to teach my children (who had extreme subtle spirits, and a great tenderness through his whole body, and met with few distractions, to hinder him from observing any impression, never so nicely made upon him) used often to tell me, that he felt it very preceptibly in several parts of his body; but especially in his brain.

7. The fifth reason; because such properties belong to light, as agree onely unto bodies.

But to settle us more firmly in the perswasion of light's being a body (and consequently fire;) let us consider that the properties or a body, are perpetually incident to light; look what rules a ball will keep in its rebounds, the same doth light in its

its reflexions: and the same demonstration doth alike convince the one and the other. Besides, light is broken like a body; as when it is snapped in peices by a tougher body. It is gathered together into a little room by looking or burning glasses; as water is, by ordering the gutters of a house so as to bring into one cistern all that raineth dispersedly upon the whole roof. It is selered and dispered by other glasses; and is to be wrought upon, and cast hither and thither at pleasure; all by the rule of other bodies. And what is done in light, the same will likewise be done in heat, in cold, in wind, and in sound. And the very same instruments that are made for light, will work their effects in all these others, if they be duly managed.

So that certainly, were it not for the authority of *Aristotle* and of his learned followers that presseth us on the one side; and for the seemingness of those reasons we have already mentioned, which perswadeth us on the other side; our very eyes would carry us by stream into this consent, that light is no other thing but the nature and substance of fire, spred far and wide, and freed from the mixture of all other gross bodies. Which will appear yet more evident in the solutions of the oppositions we have brought against our own opinion: for in them there will occur other arguments of no less importance to prove this verity, than these we have already proposed.

CHAP. VII.

Two objections answered against light being fire; with a more ample proof of its being such.

1. That all light is hot and apt to heat.

HAving then said thus much to perswade us of the corporeity of this subtle thing, that so queintly playeth with our eyes: we will in the next place examine those objections that at the beginning we did set down against its being a body: and if after a through discussion of them, we find they do in truth conclude nothing of what at the first sight they bear so great a shew of; but that we shall be able perfectly to solve and enerve their force; no body will think it rashness in us to crave leave of *Aristotle* that we may dissent from him in a matter that he hath not looked to the bottom of; and whose opinion therein can-

cannot be defended from plain contradictions and impossibilities. It is true, never any one man looked so far as he into the bowels of nature; he may be rightly termed the genius of it; and whosoever followeth his principles in the main, cannot be led into error; but we must not beleive that he or any man else that relieth upon the strength and negotiation of his own reason, ever had a privilege of infallibility entailed to all he said. Let us then admire him for what he hath dilivered us: and where he falleth short or is weary in his search, and suffereth himself to be born down by popular opinions, against his own principles (which happeneth very seldom to him (let us seek to supply and relieve him.

But to pursue our intent: We will begin with answering the third objection; which is, That if light were fire, it must heat as well as enlighten where it shineth. There is no doubt but it doth so: as is evident by the weather-glasses, and other artificial musical instruments (as organs and virginals that playd by themselves) which *Cornelius Drebbel* (that admirable master of mechanicks) made to shew the king. All which depended upon the rarefaction and condensation of some subtile body, conserved in a cavitie within the bulk of the whole instrument: for assoon as the sun shined, they would have motion and play their parts. And there is no doubt but that grew out of the rarefaxion of the subtle liquor he made use of, which was dilated assoon as the air was warmed by the sun-beams. Of whose operation it was so sensible, that they no sooner left the horizon, but its motion ceased. And if but a cloud came between the instrument and them, the musick would presently go slower for a time. And the ancient miracle of *Memnons* statue, seemeth to be a juggling of the *Ethiopian* priests made by the like invention.

2. The reason why our bodies for the most part do not feel the heat of pure light.

But though he and they found some spiritual and refined matter: that would receive such notable impressions, from so small alterations of temper; yet it is no wonder that our grosse bodies are not sensible of them: for we cannot feel heat unlesse it be greater than that which is in our sense. And the heat there must be in proportion to the heat of our blood; which is an high degree of warmth. And therefore it is very possible

sible that an exceeding rarified fire, may cause a far less impression of heat than we are able to feel. Consider how if you set pure spirit of wine on fire, and so convert it into actual flame; yet it will not burn, nor scarce warm your hand: and then can you expect that the light of a candle which filleth a great room, should burn and warm you so far as it shineth?

If you would exactly know what degree of heat, and power of burning that light hath, which (for example) shineth upon the wall in a great chamber, in the middest whereof there standeth a candle; do but calculate what over-porportion of quantity all the light in the whole room beareth to the quantity of the little flame at the top of the candle, and that is the over-proportion of the force of burning which is in the candle, to the force of burning which is in so much light at the wall as in extension is equal to the flame of the candle. Which when you have considered, you will not quarrel at its not warming you at that distance; although you grant it to be fire, streaming out from the flame as from the spring that feedeth it, and extremely dilated (according to the nature of fire, when it is at liberty) by going so far, without any other gross body to imprison or clog it.

It is manifest, that this rule of examining the proportion of burning in so much of the light as the flame is, (by calculating the proportion of the quantity or extension of all the light in the room to the extension of the flame of the candle, and then comparing the flame of the candle to a part of light equal in extension unto it) is a good and infallible one, if we abstract from accidental inequalities: since both the light and the flame are in a perpetual flux; and all the light was first in the flame, which is the spring from whence it continually floweth. As in a river wherein every part runneth with a setled stream; though one place be straighter, and another broader; yet of necessity, since all the water that is in the broad place came out of the narrow, it must follow that in equal portions of time, there is no more water where it hath the liberty of a large channel, than where the banks press it into a narrow bed, so that there be no inequalities in the bottom.

In like manner, if in a large stove a basin of water be converted

verted into steam, that rarified water which then filleth the whole stove, is no more than what the basin contained before: and consequently, the power of moistening which is in a foots extension (for example) of the stove wherein that steam is, must be in proportion to the vertue of wetting in the foots extension of water; as the quantity of that great room which the steam filleth, is to the quantity of the water contained in the bason: for although the rarified water be not in every least part of that great place it seemeth to take up; by reason that there is air in which it must swim; yet the power of wetting that was in the bason of water, is dilated through the whole room, by the conjunction of the mist or dew to all the sensible parts of the air that is in the room: and consequently the power of wetting which is in any foot of that room, is in a manner as much less than the power of wetting which was in the foot of water, as if the water were rarified to the quantity of the whole room, and no air were left with it.

And in the same manner it fareth with dilated fire, as it doth with dilated water, with onely this difference peradventure, that fire groweth purer and more towards its own nature by dilatation; whereas water becometh more mix'd, and is carried from its nature by suffering the like effect. Yet dilated water will in proportion moisten more than dilated fire will burn; for the rarefaction of water bringeth it nearer to the nature of air (whose chief propriety is moisture,) and the fire that accompanieth it when it raiseth it into steam, giveth it more powerfull ingression into what body it meeteth withall: whereas fire when it is very pure, and at entire liberty to stretch and spread it self as wide as the nature of it will carry it, getteth no advantage of burning by its mixture with air: and although it gaineth force by its purity, yet by reason of its extreme rarefaction it must needs be extremely faint. But if by the help of glasses you will gather into less room that which is diffused into a great one, and so condense it as much as it is (for example) in the flame of a candle; then that fire or compacted light will burn much more forcibly than so much flame: for there is as much of it in quantity (excepting what is lost in the carriage of it;) and it is held in together in as little room; and it hath this advantage besides,

beſides, that it is clogged with no groſs body to hinder the activity of it.

3. The experience of burning-glaſſes, and of foultry gloomy weather, prove light to be fire.

It ſeemeth to me now, that the very anſwering this objection doth (beſides repelling the force of it) evidently prove that light is nothing but fire in his own nature, and exceedingly dilated: for if you ſuppoſe fire (for example the flame of a candle) to be ſtretched out to the utmoſt expanſion that you may well imagin ſuch a groſs body is capable of; it is impoſſible it ſhould appeare and worke otherwiſe than it doth in light, as I have ſhewed above. And again, we ſee plainly that light gathered together burneth more forcibly than any other fire whatſoever, and therefore muſt needs be fire.

Why then ſhall we not confidently conclude, that what is fire before it getteth abroad, and is fire again when it cometh together, doth likewiſe remain fire during all its journey? Nay even in the journey it ſelf we have particular teſtimony that it is fire: for light returning back from the earth charged with little atoms (as it doth in ſoultry gloomy weather) heateth much more than before; juſt as fire doth when it is impriſoned in a denſe body.

4. Philoſophers ought not to judge of things by the rules of vulgar people.

Philoſophers ought not to judge by the ſame rules that the common people doth. Their groſs ſenſe is all their guide: and therefore they cannot apprehend any thing to be fire, that doth not make it ſelf be known for ſuch by burning them. But he that judiciouſly examineth the matter, and traceth the pedigree and period of it; and ſeeth the reaſon why in ſome circumſtances it burneth, and in other parts it doth not; is too blame, if he ſuffer himſelf to be led by others ignorance contrary to his own reaſon. When they that are curious in perfumes, will have their chamber filled with a good ſcent in a hot ſeaſon that agreeth not with burning perfumes, and therefore do make ſome odoriferous water be blown about it by their ſervants mouths that are dexterous in that miniſtery, (as is uſed in *Spain* in the ſummer time;) every one that ſeeth it done, though on a ſudden the water be loſt to his eyes and touch, and is onely diſcernable by his noſe; yet he is well ſatisfied that the ſcent which recreateth him, is the very water he ſaw in the glaſs extremely dilated by the forcible ſprouting of it out from the ſervants mouth, and will by little and little fall down and become again palpable

pable water as it was before; and therefore doubteth not but it is still water whiles it hangeth in the air divided into little atoms. Whereas one that saw not the beginning of this operation by water, nor observed how in the end it sheweth it self again in water, might the better be excused if he should not think that what he smelled were water blown about the air, nor any substance of it self (because he neither seeth nor handleth it) but some adventitious quality he knoweth not how adhering to the air. The like difference is between Philosophers that proceed orderly in their discourses, and others that pay themselves with terms which they understand not. The one see evidence in what they conclude; whiles the others guesse wildly at random.

5. The different names of light and fire proceed from different notions of the same substance.

I hope the Reader will not deem it time lost from our main drift, which we take up thus in examples and digressions: for if I be not much deceived, they serve exceedingly to illustrate the matter: which I hope I have now rendred so plain, as no man that shall have well weighed it, will expect that fire dilated into that rarified substance which mankinde (who according to the different appearance of things to their sense, giveth different names unto them) calleth light, should burn like that grosser substance which from doing so they call fire; nor doubt but that they may be the same thing more or lesse attenuated; as leaf-gold that flieth in the air as light as down, is as truly gold as that in an ingot which being heavier than any other substance, falleth most forcibly unto the ground.

What we have said of the unburning fire (which we call light) streaming from the flame of a candle, may easily be applyed to all other lights deprived of sensible heat, whereof some appear with flame, others without it: of the first sort of which, are the innoxious flames, that are often seen on the hair of mens heads, and horses manes, on the masts of ships, over graves, and fat marish grounds, and the like: and of the latter sort are glow-worms, and the light-conserving stones, rotten wood, some kindes of fish and of flesh when they begin to putrifie, and some other things of the like nature.

6.

Now to answer the second part of this objection, that we daily see great heats without any light, as well as much light with-

The reaſon why many times fire and heat are deprived of light.

without any heat, and therefore light and fire cannot be the ſame thing: you may call to minde how denſe bodies are capable of great quantities of rare ones; and thereby it cometh to paſſe, that bodies which repugn to the dilatation of flame, may nevertheleſſe have much fire encloſed in them. As in a ſtove, let the fire be never ſo great, yet it appeareth not outwards to the ſight, although that ſtove warm all the rooms neer it: So when many little parts of heat are impriſoned in as many little cells of groſs earthly ſubſtance, (which are like ſo many little ſtoves to them) that impriſonment will not hinder them from being very hot to the ſenſe of feeling (which is moſt perceptible of denſe things.) But becauſe they are choaked with the cloſeneſs of the groſſe matter wherein they are encloſed, they cannot break out into a body of flame or light, ſo to diſcover their nature: which (as we have ſaid before) is the moſt unfit way for burning; for we ſee that light muſt be condenſed to produce flame and fire; as flame muſt be to burn violently.

Having thus cleared the third objection, (as I conceive;) let us go on to the fourth; which requireth that we ſatisfie their inquiſition, who ask what becometh of that vaſt body of ſhining light (if it be a body) that filleth all the diſtance between heaven and earth; and vaniſheth in a moment as ſoon as a cloud or the Moon interpoſeth it ſelf between the Sunne and us, or that the Sun quitteth our Hemiſphear? No ſigne at all remaineth of it after the extinction of it, as doth of all other ſubſtances, whoſe deſtruction is the birth of ſome new thing. Whither then is it flown? We may be perſwaded that a miſt is a corporeall ſubſtance, becauſe it turneth to drops of water upon the twigs that it invironeth: and ſo we might believe light to be fire, if after the burning of it out, we found any aſhes remaining; but experience aſſureth us, that after it is extinguiſhed, it leaveth not the leaſt *veſtigium* behind it of having been there.

7. What becometh of the body of light when it dieth.

Now, before we anſwer this objection, we will entreat our adverſary to call to minde, how we have in our ſolution of the former declared and proved that the light, which (for example) ſhineth from a candle, is no more than the flame is, from whence it ſpringeth, the one being condenſed and the other dilated; and that the flame is in a perpetual flux of conſumption

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about the circumference, and of restauration at the center, where it sucketh in the fewel: and then we will enquire of him, what becometh of that body of flame which so continually dieth and is renewed, and leaveth no remainder behinde it; as well as he doth of us, what becometh of our body of light, which in like manner is alwaies dying, and alwaies springing fresh? And when he hath well considered it, he will finde that one answer will serve for both.

Which is, That as the fire streameth out from the fountain of it, and groweth more subtile by its dilatation, it sinketh the more easily into those bodies it meeteth withall: the first of which, and that environeth it round about, is air. With air then it mingleth and incorporateth it self, and by consequence with the other little bodies that are mingled with the air: and in them it receiveth the changes which nature worketh: by which it may be turned into the other elements, if there be occasion; or be still conserved in bodies that require heat.

8. An experiment of some who pretend, that light may be precipitated into powder.

Upon this occasion, I remember a rare experiment that a noble man of much sincerity, and a singular friend of mine, told me he had seen: which was, That by means of glasses made in a very particular manner, and artificially placed one by another, he had seen the sun-beams gathered together, and precipitated down into a brownish or purplish red powder. There could be no fallacy in this operation: for nothing whatsoever was in the glasses when they were placed and disposed for this intent: and it must be in the hot time of the year, else the effect would not follow. And of this Magistry he could gather some daies neer two ounces in a day. And it was of a strange volatile nature, and would pierce and imprint his spiritual quality into gold it self (the heaviest and most fixed body we converse withall) in a very short time. If this be plainly so, without any mistaking; then mens eyes and hands may tell them what becometh of light when it dieth, if a great deal of it were swept together. But from what cause soever this experience had its effect, our reason may be satisfied with what we have said above; for I confesse, for my part, I believe the appearing body might be something that came along with the sun-beams, and was gathered by them; but not their pure substance.

Some peradventure will object those lamps, which both antient

9. The Authors opinion concerning lamps pretended to have been found in tombs with inconsumptible lights.

tient and modern writers have reported to have been found in tombs and urns, long time before closed up from mens repair unto them to supply them with new fewel: and therefore they believe such fires to feed upon nothing; and consequently, to be inconsumptible and perpetual. Which if they be, then our doctrine that will have light to be nothing but the body of fire perpetually flowing from its center, and perpetually dying; cannot be found: for in time such fires would necessarily spend themselves in light: although light be so subtile a substance that an exceeding little quantity of fewell may be dilated into a vast quantity of light. Yet still there would be some consumption, which how imperceptible soever in a short time, yet after a multitude of revolutions of years, it must needs discover it self.

To this I answer: That for the most part, the witnesses who testifie originally the stories of these lights, are such as a rational man cannot expect from them that exactnesse or nicety of observation. which is requisite for our purpose; for they are usually gross labouring people, who as they dig the ground for other intentions, do stumble upon these lamps by chance before they are aware: and for the most part, they break them in the finding; and they imagine they see a glimpse of light, which vanisheth before they can in a manner take notice of it; and is peradventure but the glistering of the broken glasse or glazed pot, which reflecteth the outward light as soon as by rummaging in the ground and discovering the glass, the light striketh upon it; (in such manner as sometimes a Diamond by a certain encountring of light in a dusky place, may in the first twickling of the motion, seem to sparkle like fire:) and afterwards when they shew their broken lamp, and tell their tale to some man of a pitch of wit above them, who is curious to inform himself of all the circumstances that may concern such lights; they strain their memory to answer him satisfactorily unto all his demands: and thus for his sake they perswade themselves to remember what they never saw: and he again on his side, is willing to help out the story a little. And so after a while, a very formal and particular relation is made of it. As happeneth in like sort in reporting of all strange and unusuall things; which even those that in their nature

nature abhor from lying are naturally apt to strain a little and fashion up in a handsome mould, and almost to perswade themselves they saw more than they did: so innate it is to every man, to desire the having of some preeminence beyond his neighbour; be it but in pretending to have seen something which they have not.

Therefore, before I engage my self in giving any particular answer to this objection of pretended inconsumptible lights, I would gladly see the effect certainly averred and undoubtedly proved: for, the testimonies which *Fortunius Licetus* produceth (who hath been very dilient in gathering them, and very subtile in discoursing upon them, and is the exactest authour that hath written upon this subject) do not seem unto me to make that certainty, which is required for the establishing of a ground in Philosophy. Nevertheless, if there be any certain experience in this particular, I should think that there might be some Art by circulation of fewell, to maintain the same light for a great company of years. But I should not easily be perswaded, that either flame or light could be made without any manner of consuming the body which serveth them for fewel.

CHAP. VIII.

An answer to three other objections formerly proposed, against light being a substance.

HAving thus defended our selves from their objections, who would not allow light to be fire; and having satisfied their inquisition, who would know what becometh of it when it ditcheth, if it be a body: we will now apply our selves to answer their difficulties, who will not let it Pass for a body, because it is in the same place with another body; as, when the sun beames enlighten all the air, and when the severall lights of two distinct candles are both of them every where in the same room. Which is the substance of the second main objection.

1. Light is not really in every part of the room it inlightneth, nor filleth entirely any sensible part of it, though it seem to us to do so.

This of the justling of the air, is easily answered thus: that the air being a very divisible body, doth without resistance yeeld as much place as is requisite for light. And that light,

though our eyes judge it diffused every where, yet is not truly in every point or atom of air: but to make us see it every where, it sufficeth that it be in every part of the air which is as big as the black or sight of our eye; so that we cannot set our eye in any position where it receiveth not impressions of light. In the same manner as perfumes; which though they be so gross bodies that they may be sensibly wafted by the wind; nevertheless, they do so fill the air, that we can put our nose in no part of the room, where a perfume is burned, but we shall smell it. And the like is of mists; as also of the sprouted water to make a perfume, which we mentioned above.

But because pure discourses, in such small thrids as these, do but weakly bind such readers as are not accustomed unto them; and that I would (if it be possible) render this Treatise intelligible to every rational man, how ever little versed in scholastick learning (among whom I expect it will have a fairer passage, than among those that are already deeply imbued with other principles:) let us try if we can herein inform ourselves by our sense, and bring our eyes for witness of what we say. He then that is desirous to satisfie himself in this particular, may put himself in a dark room, through which the sun sendeth his beames by a cranie or little hole in the wall; and he will discover a multitude of little atoms flying about in that little stream of light; which his eye cannot discern when he is environed on all sides with a full light. Then let him examine whether or no there be light in the midst of those little bodies: and his own reason will easily tell him, that if those bodies were as perspicuous as the air, they would not reflect upon our eyes the beames by which we see them. And therefore he will boldly conclude, that at the least such parts of them as reflect light unto us, do not admit it, nor let in sink into them. Then let him consider the multitude of them; and the little distance betwixt one another; and how nevertheless they hinder not our sight; but we have it free to discover all objects beyond them, in what position soever we place our eye: and when he thus perceiveth that these opacous bodies, which are every where, do not hinder the eye from judging light to have an equal plenary diffusion through the whole place that it irradiateth; he can have no difficulty to allow air, (that is diaphanous,

phanous, and more subtle far than they, and consequently, divisible into lesser atoms, and having lesser pores, giveth less scope unto our eyes to miss light, than they do) to be every where mingled with light, though we see nothing but light, and cannot discern any breach or division of it.

Especially, when he shall add unto this consideration; that the subtile body which thus filleth the air, is the most visible thing in the world; and that, whereby all other things are seen: and that the air which it mingleth it self with, is not at all visible, by reason of the extreme diaphaneity of it, and easie reception of the light into every pore of it without any resistance or reflection: and that such is the nature of light, as it easily drowneth an obscure body, if it be not too big: and not onely such, but even other light bodies; for so we know as well the fixed stars as the planets are concealed from our sight by nearness to the sun; neither the lightness of the one, nor the bigness of the other, prevailing against the darkning of an exuperant light: and we have daily experience of the same in very pure chrystal glasses, and in very clear water; which though we cannot discern by our sight if they be in certain positions; nevertheless by experience we find that they reflect much light: and consequently have great store of opacous parts: and then he cannot choose but conclude, that it is impossible but light should appear as it doth, to be every where, and to be one continued thing; though his discourse withall assure him it is every where mingled with air.

2. The least sensible point of a diaphanous body, hath room sufficient to contain both air and light, together with a multitude of beams issuing from several lights, without penetrating one another. *Willebrord Snell*

And this very answer I think will draw with it by consequence, the solution of the other part of the same objection; which is of many lights joyning in the same place; and the same is likewise concerning the images of colours every where crossing one another without hinderance. But to raise this contemplation a strain higher; let us consider how light being the most rare of all known bodies, is of its own nature (by reason of the divisibility that followeth rarity) divisible into lesser parts than any other; and particularly than flame; which being mixed with smoke and other corpulency, falleth very short of light. And this, to the proportion in which it is more rare than the body it is compared unto. Now a great Mathematician having devised how to measure the rarefaction of gun-pow-

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der into flame, found the diameter 50. times encreased; and so concluded, that the body of the flame was in proportion to the body of the gun-powder it was made of, as 125000. is to one. Wherefore by the immediately proceeding consequence, we find that 125000. parts of flame may be couched in the room of one least part of gun-powder, and peradventure many more, considering how porous a body gun-powder is. Which being admitted, it is evident, although light were as gross as the flame of gun-powder, and gun-powder were as solid as gold: yet there might pass 125000. rayes of light, in the space wherin one least part of gun-powder might be contained; which space would be absolutely invisible unto us, and be contained many times in the bigness of the sight of a mans eye. Out of which we may gather what an infinity of objects may seem unto us to cross themselves in the same indivisible place, and yet may have room sufficient for every one to pass his way, without hindering his fellow. Wherefore, seeing that one single light could not send rayes enough to fill every little space of air that is capable of light, (and the less, the farther it is from the flame) it is obvious enough to conceive, how in the space where the air is, there is capacity for the rayes of many candles.

Which being well summed up, will take away the great admiration how the beams of light, though they be corporeal, can in such great multitudes without hindering one another, enter into bodies and come to our eye: and will shew that it is the narrowness of our capacities, and not the defect of nature, which maketh these difficulties seem so great; for she hath sufficiently provided for all these subtile operations of fire; as also for the entrance of it into glass, and into all other solid bodies that are diaphanous (upon which was grounded the last instance the second objection prest:) for all such Bodies being constituted by the operation of fire (which is alwayes in motion) there must needs be wayes left for it both to enter in, and to evaporate out. And this is most evident in glass which being wrought by an extreme violent fire and swelling with it, as water and other things do by the mixture of fire; must necessarily have great store of fire in it self whiles it is boyling; as we see by its being red hot. And hence it is, that the workmen

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are forced to let it cool by degrees in such relentings of fire, as they call their nealing heats, lest it should shiver in pieces by a violent succeeding of air in the room of the fire; for that being of greater parts than the fire, would strain the pores of the glass too suddenly, and break it all in pieces to get ingression: whereas in those nealing heats the air being rarer, lesser parts of it succeed to the fire, and leisurely stretch the pores without hurt. And therefore we need not wonder that light passeth so easily through glass; and much less, that it getteth through other bodies; seeing the experience of Alchymists doth assure us, that it is hard to finde any other body so impenetrable as glass.

3. That light doth not enlighten any room in an instant; and that the great celerity of its motion doth make it imperceptible to our senses.

But now to come to the answer of the first, and in appearance most powerful, objection against the corporeity of light; which urgeth that his motion is performed in an instant, and therefore cannot belong to what is material and clothed with quantity; We will endeavour to shew how unable the sense is to judge of sundry sorts of motions of Bodies, and how grossly it is mistaken in them. And then, when it shall appear that the motion of light must necessarily be harder to be observed than those others: I conceive, all that is raised against our opinion by so incompetent a judge, will fall flat to the ground.

First then, let me put the Reader in minde, how if ever he marked children when they play with fire-sticks, they move and whirle them round so fast, that the motion will cosen their eyes, and represent an entire circle of fire unto them: and were it somewhat distant, in a dark night, that one played so with a lighted torch, it would appear a constant wheel of fire without any discerning of motion in it. And then, let him consider how slow a motion that is in respect of what it is possible a body may participate of: and he may safely conclude, that it is no wonder though the motion of light be not descried, and that indeed no argument can be made from thence, to prove that light is not a body.

But let us examine this consideration a little farther, and compare it to the motion of the earth or heavens: let the appearing circle of the fire, be some three foot diameter, and the

time of one entire circulation of it, be the ſixtieth part of a minute; of which minutes, there are 60. in an hour; ſo that in a whole day, there will be but 86400. of theſe parts of time. Now the diameter of the wheel of fire being but of three foot, the whole quantity of ſpace that it moveth in that atom of time will be at the moſt 10. foot; which is three paces and a foot: of which parts, there are neer eleven millions in the compaſs of the earth: ſo that if the earth be moved round in 24. hours, it muſt go neer 130. times as faſt as the boyes ſtick doth, which by its ſwift motion deceiveth our eye. But if we allow the Sun, the Moon, and the fixed Stars to move; how extreme ſwift muſt their flight be, and how imperceptible would their motion be in ſuch a compaſs as our ſight would reach unto? And this being certain, that whether the earth or they do move, the appearances to us are the ſame; it is evident, that as now they cannot be perceived to move (as peradventure they do not;) ſo it would be the very ſame in ſhew to us, although they did move. If the Sun were neer us, and galloped at that rate; ſurely we could not diſtinguiſh between the beginning and ending of his race: but there would appear one permanent line of light from Eaſt to Weſt, without any motion at all: as the torch ſeemeth to make, with ſo much a ſlower motion, one permanent immovable wheel of fire.

But contrary to this effect, we ſee that the Sun and Stars by onely being removed farther from our eyes, do coſen our ſight ſo groſſely that we cannot diſcern them to be moved at all. One would imagine that ſo rapid and ſwift a motion, ſhould be perceived in ſome ſort or other, (which, whether it be in the earth, or in them, is all one to this purpoſe.) Either we ſhould ſee them change their places whiles we look upon them, as arrows and birds do when they fly in the air; or elſe, they ſhould make a ſtream of light bigger than themſelves, as the torch doth. But none of all this happeneth: let us gaze upon them ſo long and ſo attentively that our eyes be dazled with looking, and all that while they ſeem to ſtand immovable: and our eyes can give us no account of their journey till it be ended. They diſcern it not whiles it is in doing:

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so that if we consult with no better counselour than them, we may wonder to see that body at night setting in the West, which in the morning we beheld rising in the East.

But that which seemeth to be yet more strange, is, that these bodies move crosse us, and nevertheless are not perceived to have any motion at all. Consider then how much easier it is for a thing that moveth towards us, to be with us before we are aware. A nimble fencer will put in a thrust so quick, that the foil will be in your bosome, when you thought it a yard off; because in the same moment you saw his point so far distant, and could not discern it to move towards you, till you felt the rude salutation it gave you. If then you will compare the body of light with these others that thus deceive us in regard of motion, you must needs agree it is much rashnesse to conclude it hath no motion, because we cannot discern the succession of. Consider that it is the subtilest of all the bodies that God hath made. Examine the paths of it, which for the smalnesse of their thrids, and the extreme divisibility of them, and their pliant application of themselves to whatsoever hath pores, are almost without resistance. Calculate the strange multiplication of it, by a perpetual momentary renovation of its streams. And cast with your self, with what extreme force it springeth out and flyeth abroad. And on the other side, reflect how all these things are directly opposite and contrary in those other great bodies, whose motion nevertheless appeareth not unto us till it be done and past. And when you have well weighed all this, you must needs grant that they who in this case guide themselves meerly by what appeareth unto their eyes, are ill judgers of what they have not well examined.

4. The reason why the motion of light is not discerned coming towards us; and that there is some real tardity in it.

But peradventure some who cannot all of a sudden be weaned from what their sense hath so long fed them with; may ask yet farther, How it chanceth that we have no effects of this motion? It sheweth not it self in the air, coming to us a far off. It stayeth not a thought, or slackneth his speed in flying so vast a space as is from the Sun to us. In fine, there is no discovery of it.

But if *Galileus* his conception be well grounded, that lightning giveth us an incling of its motion, beginning from a little and encreasing to a greater; or if *Monsieur des Cartes* his opinion that it goeth slower in refraction, be true: we shall not need to study long for an answer. But in *Galileus* his experience, it may be the breaking of the cloud which receiveth that succession of motion which we see: and no slowness that light can acquire by the resistance of the refracting body, can be so great as to make that difference of lines which *Monsieur Des Cartes* most ingeniously (though I much doubt not truly) hath applied to yield the reason of refraction: as will appear in our farther discourse.

Therefore these being uncertain; we will, to shew the unreasonableness of this question, suppose there may be some observable tardity in the motion of light; and then ask of them, how we should arrive to perceive it? What sense should we imploy in this discovery? It is true, we are satisfied that sound taketh up time in coming to our eares: but it is, because our eyes are nimbler than they, and can perceive a good way distant the Carpenters Ax falling upon the timber that he heweth, or the fire flashing out of the Canon, before they hear any news of them: but shut your eyes; or inquire of a blinde man; and then neither you nor he can tell whether those sounds fill your eares at the very instant they were begotten, or have spent some time in their journey to you. Thus then our eyes instruct our eares. But is there any sense quicker than the sight? or means to know speedier than by our eyes? Or can they see light, or any thing else; untill it be with them? We may then assuredly conclude, that its motion is not to be discerned as it cometh upon us; nor it self to be perceived, till its beams are in our eyes.

But if there were any means to discover its motion, surely it must be in some *medium*, through which it must struggle to get, as fire doth through iron; which increasing there by degrees, at last (when it is red hot) sendeth beams of light quite through the plate that at the first refused them passage. And it maketh to this purpose, that the light-conserving stones which are gathered in *Italy*, must be set in the Sun for some while before they retain light: and the light will appear in them when

when they are brought back into the dark, greater or leſſer (untill they come to their utmoſt period) according as they have been longer or a leſſer while in the Sun. And our eyes the longer they remain in the light, the more dazled they are if they be ſuddenly paſſed into the dark. And a curious experiencer did affirm, that the likeneſs of an object (but paritcularly he had often obſerved it of an iron grate) if it be ſtrongly inlightned will appear to another, in the eye of him that looketh ſtronxly and ſteadily upon it till he be dazled by it, even after he ſhall have tutned his eyes from it. And the wheel of fire could never be made appear unto our eye by the whirling of the fire-ſtick we even now ſpoke of; unleſs the impreſſion made by the fire from one place, did remain in the eye a while after the fire was gone from the place whence it ſent that ray. Whence it is evident, that light, and the pictures of objects, do require time to ſettle and to unſettle in a ſubject. If then light maketh a greater impreſſion with time, why ſhould we doubt but the firſt cometh alſo in time; were our ſenſe ſo nimble as to perceive it?

5. The planets are not certainly ever in that place where they appear to be.

But then it may be objected, that the Sun would never be truly in that place in which unto our eyes it appeareth to be: becauſe that, it being ſeen by means of the light which iſſueth from it; if that light required time to move in, the Sun (whoſe motion is ſo ſwift) would be removed from the place where the light left it, before it could be with us to give tidings of him. To this I anſwer, allowing that peradventure it may be ſo. Who knoweth the contrary? Or, what inconvenience would follow, if it be admitted? Indeed, how can it be otherwiſe? In refraction, we are ſure it is ſo: and therefore at no time but when the Sun is perpendicularly over our heads, we can be certain of the contrary although it ſhould ſend its light to us in an inſtant. Unleſſe happily the truth of the caſe ſhould be, that the Sun doth not move about us; but we turn to his light: and then, the objection alſo loſeth its aim.

6. The reaſon why light being a body, doth not by its motion ſhatter other bodies into pieces.

But the more we preſs the quickneſs of light, the more we ingage our ſelves, in the difficulty why light doth not ſhatter the air in pieces, as likewiſe all ſolid bodies whatſoever: for the maſters of natural Philoſophy do tell us, that a ſofter thing with

with a great velocity, is as powerful in effect when it giveth a blow, as a harder thing going slowly. And accordingly experience teacheth us, that a tallow candle shot in a gun will go through a board, or kill a man. Wherefore light having such an infinite celerity, should also have an unresistable force, to pierce and sharter, not onely the air, but even the hardest bodies that are. Peradventure some may think it reasonable to grant the consequence (in due circumstances) since experience teacheth us, that the congregation of a little light by a glass, will set very solid bodies on fire, and will melt metals in a very short space; which sheweth a great activity: and the great activity sheweth a great percussion, burning being effected by a kind of attrition of the thing burned. And the great force which fire sheweth in guns, and in mines, being but a multiplication of the same, doth evidently convince that of its own nature it maketh a strong percussion, when all due circumstances concurre. Whereas it hath but little effect if the due circumstances be wanting; as we may observe in the insensible burning of so rarified a body as pure spirit of wine converted into flame.

But we must examine the matter more particularly, and must seek the cause why a violent effect doth not alwaies appear, wheresoever light striketh; for the which we are to note that three things do concur to make a percussion great: The bigness, the density, and the celerity of the body moved. Of which three there is onely one in light; to wit, celerity: for it hath the greatest rarity, and the raies of it are the smallest parcels of all natural bodies. And therefore since onely celerity is considerable in the account of lights percussions, we must examine what celerity is necessary to make the stroke of a ray sensible: first then we see that all the motes of the air, nay, even feathers and straws, do make no sensible percussion when they fall upon us: therefore we must in light have at the least a celerity that may be to the celerity of the straw falling upon our hand (for example,) as the density of the straw is to the density of light, that the percussion of light may be in the least degree sensible. But let us take a corn of gun-powder in stead of a straw (between which there cannot be much difference) and then putting that the density of fire is to the density of gun-powder as

1. to

1. to 125000; and that the denſity of the light we have here in the earth, is to the denſity of that part of fire whic h is in the Suns body, as the body of the Sun is to that body which is called *Orbis magnus* (whoſe ſemidiameter is the diſtance between the Sun and the Earth;) which muſt be in ſubtriple proportion of the diameter of the Sun to the diameter of the great Orb: it followeth that 125000. being multiplied by the proportion of the great Orb unto the Sun (which *Galileo* telleth us is as 106000000 unto one) will give a ſcantling of what degree of celerity light muſt have more than a corn of gun-powder, to recompence the exceſs of weight which is in a corn of gun-powder, above that which is in a ray of light, as big as a corn of gun-powder. Which will amount to be much greater than the proportion of the ſemidiameter of *Orbis magnus*, to the ſemidiameter of the corn of gun-powder: for if you reckon five grains of gun-powder to a barly-corns breadth, and 12. of them in an inch, and 12. inches in a foot, and 3. feet in a pace, and 1000. paces in a mile, and 3500. miles in the ſemidiameter of the earth, and 1208. ſemidiameters of the earth in the ſemidiameter of the *Orbis magnus*, there will be in it but 9132,8000000. grains of gun-powder; whereas the other calculation maketh light to be 1325000000,0000. times rarer than gun-powder; which is almoſt ten times a greater proportion than the other. And yet this celerity ſupplieth but one of the two conditions wanting in light to make its percuſſions ſenſible, namely denſity. Now becauſe the ſame velocity in a body of a leſſer bulk, doth not make ſo great a percuſſion as it doth in a bigger body; and that the littleneſs of the leaſt parts of bodies followeth the proportion of their rarity; this vaſt proportion of celerity muſt again be drawn into it ſelf, to ſupply for the exceſs in bigneſs that a corn of gun-powder hath over an atom of light: and the product of this multiplication will be the celerity required to ſupply for both defects. Which evidently ſheweth, it is impoſſible that a ray of light ſhould make any ſenſible percuſſion, though it be a body. Eſpecially conſidering that ſenſe never taketh notice of what is perpetually done in a moderate degree. And therefore after this minute looking into all circumſtances, we need not have difficulty in allowing unto light the greateſt celerity imaginable, and a percuſſion proportionate to ſuch a celerity in ſo rare a body; and

and yet not fear any violent effect from its blows: unleſs it be condenſed, and many parts of it be brought together to work as if they were but one.

7. The reaſon why the body of light is never perceived to be fanned by the wiud.

As concerning the laſt objection; that if light were a body, it would be fanned by the wind: we muſt conſider what is the cauſe of a things appearing to be moved: and then examine what force that cauſe hath in light. As for the firſt part; we ſee that when a body is diſcerned now in one place, now in another, then it appeareth to be moved. And this we ſee happeneth alſo in light; as when the Sun or a candle is carried or moveth, the light thereof in the body of the candle or Sun ſeemeth to be moved along with it. And the like is in a ſhining cloud or comet.

But to apply this to our purpoſe: We muſt note that the intention of the objection is, that the light which goeth from the fire to an opacous body far diſtant without interruption of its continuity, ſhould ſeem to be jogged or put out of its way by the wind that croſſeth it. Wherein the firſt failing is, that the objector conceiveth light to ſend ſpecies unto our eye from the midſt of its line: whereas with a little conſideration he may perceive, that no light is ſeen by us but that which is reflected from an opacous body to our eye: ſo that the light he meaneth in his objection is never ſeen at all. Secondly, it is manifeſt, that the light which ſtriketh our eye, doth ſtrike it in a ſtraight line; and ſeemeth to be at the end of that ſtraight line, whereſoever that is; and ſo can never appear to be in another place: but the light which we ſee in another place, we conceive to be another light. Which maketh it again evident, that the light can never appear to ſhake, though we ſhould ſuppoſe that light may be ſeen from the middle of its line; for no part of wind or air can come into any ſenſible place in that middle of the line, with ſuch ſpeed that new light from the ſource doth not illuminate it ſooner than it can be ſeen by us: wherefore it will appear to us illuminated, as being in that place: and therefore the light can never appear ſhaken. And laſtly, it is eaſier for the air or wind to deſtroy the light, than it is remove it out of its place, wherefore it can never ſo remove it out of its place, as that we ſhould ſee it in another place. But if it ſhould remove it, it would wrap it up within it ſelf and hide it.

8. In concluſion; after this long diſpute concerning the nature of

of light: if we consider well what hath been said on both sides (to which much more might be added, but that we have already trespass'd in length, and I conceive enough is said to decide the matter) an equal judge will find the balance of the question to hang upon these terms, that, to prove the nature of light to be material and corporeal, are brought a compny of accidents well known to be the proprieties of quantity or bodies, and as well known to be in light. Even so far as that it is manifest that light in its beginning before it be dispersed is fire; and if again it be gathered together, it sheweth it self again to be fire. And the receptacles of it are the receptacles of a body: being a multitude of pores, as the hardness and coldness of transparent things do give us to understand; of which we shall hereafter have occasion to discourse. The reasons for and against lights being a body, compared together.

On the contrary side, whatsoever arguments are brought against lights being a body, are onely negatives. As that we see not any motion of light; that we do not discern where the confines are between light and air; that wee see not room for both of them, or for more lights to be together; and the like: which is to oppose negative proofs against affirmative ones; and to build a doctrine upon the defect of our senses; or upon the likeness of bodies which are extremely unlike, expecting the same effects from the most subtle as from the most gross ones. All which together, with the authority of *Aristotle* and his followers, have turned light into darkness, and have made us almost deny the light of our own eyes.

9. A summary repetition of the reasons which prove that light is fire.

Now then, to take our leave of this important question: let us return to the principles from whence we began, and consider; that seeing fire is the most rare of all the Elements, and very dry: and that out of the former it hath, that it may be cut into very small pieces; and out of the latter, that it conserveth its own figure, and so is apt to divide whatsoever fluid body: and joyning to these two principles, that it multiplieth extremely in its source; it must of necessity follow, that it shooteth out in great multitudes little small parts into the air and into other bodies circumfused with great dilatation in a spherical manner. And likewise that these little parts are easily broken; and new ones still following the former, are still multiplyed in straight lines from the place where they break. Out of which it is evident

dent that of necessity it must in a manner fill all places, and that no sensible place is so little, but that fire will be found in it if the medium be capacious. As also, that its extreme least parts will be very easily swallowed up in the parts of the air, which are humid; and by their enfolding, be as it were quite lost; so as to lose the appearance of fire. Again; that in its reflections, it will follow the nature of grosser bodies, and have glidings like them; which is that, we call refractions. That little streamings from it will cross one another in excessive great numbers, in an unsensible part of space, without hindring one another. That its motion will be quicker than sense can judge of; and therefore will seem to move in an instant, or to stand still as in a stagnation. That if there be any bodies so porous with little and thick pores; as that the pores arrive near unto equalling the substance of the body; then, such a body will be so filled with these little particles of fire, that it will appear as if there were no stop in its passage, but were all filled with fire; and yet, many of these little parts will be reflected. And whatsoever qualities else we find in light, we shall be able to derive them out of these principles, and shew that fire must of necessity do what experience teacheth us that light doth. That is to say in one word, it will shew us that fire is light. But if fire be light, then light must needs be fire. And so we leave this matter

CHAP. IX.

Of Local motion in common.

1. No local motion can be performed without succession.

THough in the fifth chapter, we made onely earth the pretender in the controversie against fire for superiority in activity; (and in very truth, the greatest force of gravity doth appear in those bodies which are eminently earthy:) nevertheless, both water and air (as appeareth out of the 4. chapter of the elements) do agree with earth in having gravity. And gravity, is the chief virtue to make them efficients. So that upon the matter, this plea is common to all the three Elements.

Wherefore, to explicate this vertue, whereby these three weighty Elements do worke; let us call to mind what we said in the beginning of the last chapter concerning local motion: to wit, that according as the body moved, or the divider did more and more enter into the divided body; so, it did join it self to

some

ſome new parts of the medium or divided body, and did in like manner forſake others. Whence it happeneth that in every part of motion, it poſſeſſeth a greater part of the medium than it ſelf can fill at once. And becauſe by the limitation and confinedneſs of every magnitude unto juſt what it is, and no more; it is impoſſible that a leſſer body ſhould at once equaliſe a greater: it followeth that this diviſion or motion whereby a body attaineth to fill a place bigger than it ſelf, muſt be done ſucceſſively: that is, it muſt firſt fill one part of the place it moveth in, then another; and ſo proceed on, till it have meaſured it ſelf with every part of the place from the firſt beginning of the line of motion, to the laſt period of it where the body reſteth.

By which diſcourſe it is evident, that there cannot in nature be a ſtrength ſo great as to make the leaſt or quickeſt moveable that is, to paſs in an inſtant, or all together, over the leaſt place that can be imagined: for that would make the moved body (remaining what it is, in regard of its bigneſs) to equaliſe and fit a thing bigger than it is. Therefore it is manifeſt, that motion muſt conſiſt of ſuch parts as have this nature, that whiles one of them is in being, the others are not yet: and as by degrees every new one cometh to be, all the others that were before, do vaniſh and ceaſe to be. Which circumſtance accompanying motion, we call Succeſſion.

2. Time is the common meaſure of all ſucceſſion.

And whatſoever is ſo done, is ſaid to be done *in time*: which is the common meaſure of all ſucceſſion, for the change of ſituation of the ſtars, but eſpicially of the ſun and moon, is obſerved more or leſs by all mankind: and appeareth alike to every man: and (being the moſt known, conſtant, and uniform ſucceſſion that men are uſed unto) is as it were by nature it ſelf ſet in their way and offered unto them as fitteſt to eſtimate and judge all other particular ſucceſſions, by comparing them both to it, and among themſelves by it. And accordingly we ſee all men naturally meaſure all other ſucceſſions, and expreſs their quantities, by comparing them to the revolutions of the heavens; for dayes, hours, and yeares, are nothing elſe but they, or ſome determinate parts of them: unto ſome of which, all other motions and ſucceſſions muſt of neceſſity be referred, if we will meaſure them. And thus we ſee how all the myſtery of applying time unto particular motions, is nothing elſe but the conſidering

considering how far the Agent that moveth the sun, causeth it to go on in its journey, whiles the agent that moveth a particular body, causeth it to perform its motion.

3. what velocity is, and that it cannot be infinite.

So that it is evident, that velocity is the effect of the superproportion of the one Agent over a certain medium; in respect of the proportion which another Agent hath to the same medium. And therefore, velocity is a quality by which one succession is intrinsically distinguished from another: though our explication useth to include time in the notions of velocity and tardity. Velocity then, is the effect (as we said) of more strength in the Agent. And having before expressed, that Velocity is a kind of density; we find that this kind of density is an excellency in succession; as permanent density, is an excellency in the nature of substance; though an imperfection in the nature of quantity (by which we see, that quantity is a kind of base alloy added to substance.) And out of this it is evident, that by how much the quicker the motion is in equal mediums, by so much the agent is the perfecter which causeth it to be so quick. Wherefore, if the Velocity should ascend so much as to admit no proportion between the quickness of the one and the tardity of the other, all other circumstances being even, excepting the difference of the agents; then there must be no proportion between the agents. Nor indeed can there be any proportion between them though there were never so great differences in other circumstances, as long as those differences be within any proportion. And consequently, you see that if one agent be supposed to move in an instant, and another in time; whatsoever other differences be in the bodies moved and in the mediums; nevertheless the agent which causeth motion in an instant will be infinite in respect of the agent which moveth in time. Which is impossible: it being the nature of a body, that greater quantity of the same thing hath greater virtue than a less quantity hath; and therefore, for a body to have infinite virtue, it must have infinite magnitude.

If any shou'd say the contrary, affirming that in finite virtue may be in a finite body; I ask, whether in half that body (were it divided) the virtue would be infinite or no? If he acknowledge that it would not; I infer thence, that neither in the two parts together there can be infinite virtue: for two finites cannot compose

pose and make up one infinite. But if he will have the virtue be infinite in each half, he therein alloweth that there is no more virtue in the whole body than in one half of it: which is against the nature of bodies. Now that a body cannot be infinite in greatness, is proved in the second knot of Master *Whites* first Dialogue of the World. And thus it is evident, that by the virtue of pure bodies there can be no motion in an instant.

On the other side it followeth, that there cannot be so little a force in nature, but that giving it time enough, it will move the greatest weight that can be imagined: for the things we treat of, being all of them quantities; they may by division and multiplication, be brought unto equality. As for example; supposing the weight of a movable, to be a million of pounds; and that the mover is able to move the millioneth part of one of those pounds, in a million of years, the millioneth part of a pace, through a *medium* of a certain rarity. Now, seeing that years may be multiplied so, as to equalize the force of this mover, unto the weight of the movable: it followeth clearly that in so many millions of years, this force may move the whole weight of a million of pounds, through the determined *medium* in a determinate number of millions of years, a million of paces: for such a force is equal to the required effect; and by consequence, if the effect should not follow, there would be a compleat cause put, and no effect result from it.

4. No force so little, that is not able to move the greatest weight imaginable.

But peradventure it is needfull to illustrate this point yet farther: suppose then a weight never so great to be A, and a force never so little to be B. Now if you conceive that some other force moveth A, you must withal conceive that it moveth A some space, since all motion implieth necessarily that it be through some space: let that space be CD. And because a body cannot be moved in a space in an instant, but requireth some time to have its motion performed in; it followeth, that there must be a determined time, in which the conceived force must move the weight A through the space CD: let that time be EF. Now then, this is evident that it is all one to say that B moveth A, and to say that B moveth A through a space in a time; so that if any part of this be left out, it cannot be understood that B moveth A. therefore to expresse particularly the effect which B is to do upon A, we must say that B must move A a certain

ſpace in a certain time. Which being ſo, we may in the next place conſider that this effect of moving A may be diminiſhed 2 wayes, either becauſe the ſpace it is to be moved in, is leſſened; or the time taken up in its motion, is encreaſed: for, as it is a greater effect, to move A through the ſpace C D, in a leſs time than E F, ſo it is a leſs effect to move the ſame A, through the ſpace C D, in a greater time than E F; or through a leſs ſpace than C D in the time E F. Now then, this being ſuppoſed, that it is leſs effect to move A through C D, in a greater time than E F, it followeth alſo, that a leſſer virtue is able to move it through C D in a greater time than E F, than the virtue which is required to move it, through the ſame ſpace in the time E F. Which if it be once granted (as it cannot be denied) then multiplying the time, as much as the virtue or force required to move A through C D in the time E F is greater than the force B; in ſo much time, the force B will be able to move A through C D. Which diſcourſe is evident, if we take it in the common terms: but if it be applied to action, wherein Phyſical accidents intervene, the artificer muſt have the judgement to provide for them, according to the nature of his matter.

5. The chief principle of Mechanicks deduced out of the former diſcourſe.

Upon this laſt diſcourſe doth hang the principle which governeth Mechanicks, to wit, that the force and the diſtance of weights counterpoyſing one another, ought to be reciprocal. That is, that by how much the one weight is heavier than the other, by ſo much muſt the diſtance of the lighter from the fixed point upon which they are moved, be greater than the diſtance of the greater weight from the ſame point: for it is plain that the weight which is more diſtant, muſt be moved a greater ſpace than the neerer weight in the proportion of the two diſtances. Wherefore the force moving it muſt carry it in a velocity of the ſaid proportion to the velocity of the other. And conſequently, the Agent, or mover, muſt be in that proportion more powerfull than the contrary mover. And out of this practiſe of Geometricians in Mechanicks (which is confirmed by experience) it is made evident that if other conditions be equal, the exceſs of ſo much gravity will make ſo much velocity. And ſo much velocity in proportion, will recompence ſo much gravity.

6. No movable

Out of the precedent concluſions, another followeth: which is, that nothing recedeth from quiet or reſt, and attaineth a great degree

degree of celerity, but it must passe through all degrees of celerity that are below the obtained degree. And the like is, in passing from any lesser degree of velocity unto a greater: because it must passe through all the intermediate degrees of velocity. For by the declartion of velocity, which we have even now made, we see that there is as much resistance in the *medium* to be overcome with speed, as there is for it to be overcome in regard of the quantity; or line of extent of it: because (as we have said) the force of the Agent in counterpoises, ought to be encreased as much as the line of extent of the *medium*, which is to overcome by the Agent in equal time, doth exceed the line of extent of the *medium*, along which the resistant body is to be moved. Wherefore, it being proved that no line of extent can be overcome in an instant, it followeth, that no defect of velocity which requireth as great a superproportion in the cause, can be overcome likewise in an instant.

can passe from rest to any determinate degree of velocity, or from a lesser degree to a greater, without passing through all the intermediate degrees, which are below the obtained degree.

And by the same reason by which we prove that a movable cannot be drawn in an instant from a lower degree of velocity to a higher, it is with no lesse evidence concluded that no degree of velocity can be attained in an instant: for divide that degree of velocity into two halfe, and if the Agent had overcome the one half, he could not overcome the other half in an instant: much lesse therefore is he able to overcome the whole (that is, to reduce the movable from quiet to the said degree of velocity) in an instant.

Another reason may be, because the movers themselves (such movers as we treat of here) are bodies likewise moved, and do consist of parts: whereof not every one part, but a competent number of them, doth make the moving body to be a fit Agent able to move the proposed body in a proposed degree of celerity. Now this Agent meeting with resistance in the movable, and not being in the utmost extremity of density, but condensable yet farther, (because it is a body;) and that every resistance (be it never so small) doth worke something upon the mover (though never so hard) to condense it; the parts of the mover that are to overcome this resistance in the movable, must (to worke that effect) be condensed and brought together as close as is needfull, by this resistance of the movable to the mover; and so, the remote

parts of the mover, become neerer to the movable, which cannot be done but successively, because it includeth local motion. And this application being likewise divisible, and not all the parts flocking together in an instant to the place where they are to exercise their power; it followeth, that whiles there are fewer moving parts knit together, they must needs move less and more weakly, than when more or all of them are assembled and applied to that work. So that, the motive virtue encreasing thus in proportion to the multiplying of the parts applied to cause the motion; of necessity, the effect (which is obedience to be moved, and quickness of motion in the movable) must do so too: that is, it must from nothing, or from rest, passe through all the degrees of celerity until it arrive to that which all the parts together are able to cause.

As for example, when with my hand I strike a ball; till my hand toucheth it, it is in quiet; but then it beginneth to move; yet with such resistance, that although it obey in some measure the stroke of my hand, nevertheless it presseth the yielding flesh of my palm backwards towards the upper and bony part of it. That part then overtaking the other, by the continued motion of my hand; and both of them joyning together to force the ball away; the impulse becommeth stronger, than at the first touching of it. And the longer it presseth upon it, the more the parts of my hand do condense and unite themselves to exercise their force; and the ball therefore must yield the more; and consequently the motion of it groweth quicker and quicker, till my hand parteth from it. Which condensation of the parts of my hand encreasing successively by the parts joyning closer to one another, the velocity of the balls motion (which is an effect of it) must also encrease proportionably thereunto. And in like manner the motion of my hand and arm, must grow quicker and quicker and passe all the degrees of velocity between rest and the utmost degree it attaineth unto: for seeing they are the spirits swelling the nerves, that cause the arms motion, (as we shall hereafter shew;) upon its resistance, they flock from other parts of the body to overcome that resistance. And since their journey thither requireth time to perform it in; and that the neerest come first; it must needs follow, that as they grow more and more in number, they must more

power-

powerfully overcome the resistance; and consequently, encrease the velocity of the motion, in the same proportion as they flock thither; until it attain that degree of velocity, which is the utmost period that the power, which the Agent hath to overcome the resistance of the medium can bring it self unto. Between which and rest, or any other inferiour degree of velocity, there may be designed infinite intermediate degrees, proportionable to the infinite divisibility of time, and space, in which the mover doth move. Which degrees do arise out of the reciprocal yielding of the medium. And that is likewise divisible in the same infinite proportion.

Since then, the power of all natural Agents is limited; the mover (be it never so powerfull) must be confined to observe these proportions; and cannot pass over all these infinite designable degrees in an instant; but must allot some time (which hath a like infinity of designable parts) to ballance this infinity of degrees of velocity: and so consequently, it requireth time, to attain unto any determinate degree. And therefore cannot recede immediately from rest unto any degree of celerity, but must necessarily pass through all the intermediate ones.

Thus it is evident that all motion which hath a beginning must of necessity increase for some time. And since the works of nature are in proportion to their causes, it followeth that this encrease is in a derminate proportion. Which *Galileus* (unto whom we owe the greatest part of what is known concerning motion) teacheth us how to finde out; and to discover what degree of celerity any moveable that is moved by nature, hath in any determinate part of the space it moveth in.

Having settled these conditions of motion; we shall do well in the next place to enquire after the causes of it: as well in the body moved, as also in the mover that occasioneth the motion. And because we have already shewed, that local motion is nothing in substance but division: we may determine that those causes which contribute to division, or resist it, are the causes which make or resist local motion. It hath also been said, that Density hath in it a power of dividing; and that Rarity is the cause of being divided; likewise we have said that fire by reason of its smal parts, into wch it may be cut (which maketh them sharp) hath also an eminence in dividing: so that we have two qualities, density and tenuity

7. The conditions which help to motion, in the moveable are three in the medium one.

Dialog 1. of Motion.

or sharpness which concur actively to division. We have told you also how *Galileus* hath demonstrated that a greater quantity of the same figure and density, hath a privilege of descending faster than a lesser. And that privilege consisteth in this, that the proportion of the superficies to the body it limiteth (which proportion the greater it is, the more it retardeth) is less in a greater bulk than in a smaller.

We have therefore three conditions concurring to make the motion more efficacious: namely, the density, the sharpness, and the bulk of the moveable. And more than these three, we cannot expect to find in a moved body: for quantity hath but three determinations: one, by density and rarity; of which, density is one of the three conditions: another, by its parts; as by a foot, a span, &c. and in this way we have found that the greater excelleth the lesser: the third and last, is by its figures; and in this we find that subtile or edged quantities do prevail over blunt ones. Seeing therefore, that these three determinations be all that are in quantity; there can be no more conditions in the body moved (which of necessity is a finite quantity) but the three named.

And as for the medium which is to be divided, there is onely rarity and density (the one, to help; the other, to hinder,) that require consideration on its side. For neither figure, nor littleness and greatness, do make any variation in it. And as for the Agent, it is not as yet time, before we have looked farther into the nature of motion, to determine his qualities.

8. No body hath any intrinsecal virtue to move it self towards any determinate part of the universe.

Now then let us reflect how these three conditions do all agree in this circumstance, that they help nothing to division, unless the body in which they are, be moved and prest against the body that is to be divided, so that we see no principle to perswade us, that any body can move it self towards any determinate part or place of the universe, of its own intrinsecal inclination. For besides that the learned Authour of the Dialogues *de Mundo* (in his third Dialogue, and the second knot) hath demonstrated that a body cannot move unless it be moved by some extrinsecal agent; we may easily frame unto our selves a conceit, of how absurd it is to think that a body by a quality in it can work upon it self: as if we should say, that rarity (which is but more quantity) could work upon quantity: or that figure (which is but that the body reacheth no farther) could work upon

upon the body: and in general, that the manner of any thing can work upon that thing whose manner it is. For *Aristotle* and Saint *Thomas*, and their intelligent Commentatours, declaring the notion of *Quality*, tell us, that to be a *Quality* is nothing else but to be the determination or modification of the thing whose quality it is.

Besides, that the natural manner of operation is, to work according to the capacity of the subject: but when a body is in the midst of an uniform medium or space, the subject is equally prepared on all sides to receive the action of that body. Wherefore (though we should allow it a force to move) if it be a natural Agent, and have no understanding, it must work indifferently on all sides, and by consequence, cannot move on any side. For if you say that the Agent in this case (where the medium is uniform) worketh rather upon one side than upon another; it must be because this determination is within the Agent it self, and not out of the circumstant dispositions: which is the manner of working of those substances that work for an end of their own; that is, of understanding creatures, and not of natural bodies.

9. The increase of motion is alwaies made in the proportion of the odd numbers.

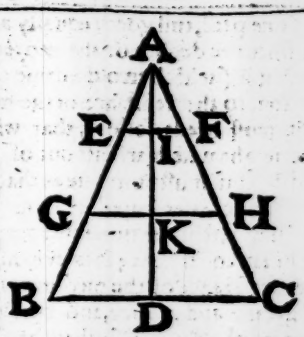
Now he that would exactly determine what motion a body hath, or is apt to have; determining by supposition the force of the Agent, must calculate the proportions of all these three conditions of the moveable, and the quality of the medium: which is a proceeding too particular for the intention of our discourse. But to speak in common, it will not be amiss to examine in what proportion motion doth increase; since we have concluded that all motion proceedeth from quiet by a continual encrease. *Galileus* (that miracle of our age, and whose wit was able to discover whatsoever he had a mind to imploy it about) hath told us that natural motion encreaseth in the proportion of the od numbers. Which to express by example, is thus: suppose that in the going of the first yard it hath one degree of velocity, then in the going of the second yard it will have three degrees, and in going of the third it will have five: and so onwards, still adding two to the degrees of the velocity, for every one to the space. Or to express it more plainly; if in the first minute of time it goeth one yard of space, then in the next minute it will go three yards, in the third it will go five, in the fourth seaven, and so forth.

But we must enlarge this proposition unto all motions, as we have done the former, of the encrease it self in velocity: because the reason of it is common to all motions. Which is, that all motion (as may appear out of what we have formerly said) proceedeth from two causes; namely, the Agent or the force that moveth, and the disposition of the body moved, as it is composed of the three qualities we lately explicated. In which is to be noted, that the Agent doth not move simply by its own virtue, but it applieth also the virtue of the body moved, which it hath to divide the medium when it is put on. As when we cut with a knife, the effect proceedeth from the knife pressed on by the hand; or from the hand as applying and putting in action the edge and cutting power of the knife. Now this in physicks and Nature is clearly parallel to what in Geometry and Arithmetick the Mathematicians call, drawing one number or one side into another; for as in the Methematicks, to draw one number into another is to apply the number drawn unto every part of the number into which it is drawn; as if we draw three into seven we make twenty one, by making every unity or part of the number seven to be three: and the like is of lines in Geometry. So in the present case, to every part of the hands motion, we add the whole virtue of the cutting faculty which is in the knife; and to every part of the motion of the knife, we add the whole pressing virtue of the hand. Therefore the encrease of the effect proceeding from two causes so working, must also be parallel to the encrease of the quantities arising out of the like drawing in Mathematicks. But in those, it is evident that the encrease is according to the order of the odd numbers, and therefore it must in our case be the like: that is, the encrease must be in the said proportion of odd numbers. Now that in those the encrease proceedeth so will be evident, if you consider the encrease of an Equicrure triangle; which because it goeth upon a certain proportion of length and breadth, if you compare the encreases of the whole triangle (that gaineth on each side) with the encreases of the perpendicular (which gaineth onely in length) you will see that they still proceed in the foresaid proportion of odd numbers.

Which will be better understood, if we set down the demonstration of it: let the Equicrure triangle be A B C: and from the

point

point A, draw the line A D perpendicular to the line B C and let it be divided into three equal parts by the lines E F and G H, in the points I and K. And I say that because the line A K is twice as long as the line A I, therefore the trapezium E F H G, is thrice as big as the triangle A E F: for as A K is to A I, so is G H to E F. But the triangle A G H



is to the triangle A E F, in a double proportion of the line G H to the line E F: which being double the proportion of one triangle to the other must be fourfold: so that substracting the triangle A E F, the trapezium E F H G remaineth thrice as big as it. And thus the whole triangle getteth an encrease of three, whiles the perpendicular is encreased but one, to make his length two. Which when it cometh to three, the trapezium G H C B that containeth the third division of the perpendicular, becometh five times as big as the triangle A E F; for since the line A D is three times as long as the line A I; and the line B C is three times as long as E F; it followeth that the triangle A B C is nine times as big as the triangle A E F; but A G H is four times as big as A E F; therefore substracting it from the whole triangle A B C, it leaveth the trapezium G H C B five times as big as the first triangle A E F. Which proposition is very ingeniously set down by the learned Monsieur *Gassendi* in his first Epistle *de motu impresso a motore translato*, to the same purpose for which we bring it. Though we do not here make use of his scheme and way of demonstration; because we had fallen upon this before his book came abroad: and therefore we onely note his to direct the Reader unto it, who peradventure may like his better than ours. Howbeit we do not conceive that he hath in his discourse there, arrived to the true reason of the effect we search into: as may appeare by what we have already delivered.

But we must not imagine, that the velocity of motion will alwaies encrease thus for as long as we can fancy any motion: but when it is arrived unto the utmost period that such a moveable with such causes is capable of, then it keepeth constantly the

10. No motion can encrease for ever without coming to a period.

the same pace, and goeth equally and uniformly at the same rate. For since the density or the moveable, and the force of the Agent moving it, (which two do cause the motion) have a limited proportion to the resistance of the medium, how yielding soever it be; it must needs follow, that when the motion is arrived unto that height which ariseth out of this proportion, it cannot exceed it, but must continue at that rate, unless some other cause give yet a greater impulse to the moveable. For velocity consisting in this, that the moveable cutteth through more of the medium in an equal time; it is evident that in the encrease of velocity, the resistance of the medium which is overcome by it, groweth greater and greater, and by little and little gaineth upon the force of the Agent; so that the super-proportion of the Agent, groweth still lesser and lesser as the velocity encreaseth: and therefore at the length they must come to be ballanced. And then the velocity can encrease no more.

And the reason of the encrease of it for a while at the beginning, is because that coming from rest, it must pass through all the intermediate degrees of velocity before it can attain to the height of it, which requireth time to perform, and therefore falleth under the power of our sense to observe. But because we see it do so for some time, we must not therefore conclude, that the nature of such motion is still to encrease, without any period or limit; like those lines that perpetually grow nearer, and yet can never meet: for we see that our reason examining the causes of this velocity, assureth us that in continuance of time and space, it may come to sti height which it cannot exceed.

And there would be the pitch at which distance weights being let fall would give the greatest strokes and make greatest impressions. It is true that *Galileus* and *Mersenius* (two exact experimenters) do think they find this verity by their experiences. But surely that is impossible to be done: for the encrease of velocity being in a proportion ever diminishing, it must of necessity come to an insensible encrease in proportion before it endeth: for the space which the moveable goeth through is still encreased; and the time wherein it passeth through that space remaineth still the same little one as was taken up in passing a less space immediately before; and such little differences of great spaces passed over in a little time, come soon to be undiscernable by sense. But reason (which sheweth us, that if velocity never ceased

from

from encreasing, it would in time arrive to exceed any particular velocity; and by consequence, the proportion which the mover hath to the medium, because of the adding still a determinate part to its velocity) concluding plainly that it is impossible, motion should increase for ever, without coming to a period.

II. Certain problems resolved concerning the proportion of some moving Agents compared to their effects.

Now the impression which falling weights do make, is of two kinds; for the body into which impression is made, either can yeeld backward, or it cannot. If it can yeeld backward, then the impression made is a motion: as we see a stroke with a racket upon a ball, or with a pail-mail beetle upon a bowl maketh it flie from it. But if the strucken body cannot yeeld backwards, then it maketh it yeeld on the sides. And this, in divers manners: for if the smitten body be dry and brittle, it is subject to break it, and make the pieces flie round about: but if it be a tough body, it squeeseth it into a larger form.

But because the effect in any of these wayes is eminently greater than the force of the Agent seemeth to be; it is worth our labour to look into the causes of it. To which end we may remember how we have already declared that the force of the velocity is equal to a reciprocal force of weight in the virtue moveth: wherefore the effect of a blow that a man giveth with a hammer, dependeth upon the weight of the hammer, upon the velocity of the motion, and upon the hand, in case the hand accompanieth the blow. But if the motion of the hand ceaseth before (as when we throw a thing) then onely the velocity and the weight of the hammer remain to be considered. Howsoever, let us put the hand and weight in one sum which we may equalize by some other virtue or weight. Then let us consider the way or space, which a weight lying upon the thing is to go forwards to do the same effect in the same time as the percussion doth. And what exceeds the line of the blow, hath over the line of that way or space; such an exceess we must add of equal weight or force, to the weight we had already taken. And the weight composed of both will be a fit Agent to make the like impression. This probleme was proposed unto me by that worthy religious man, Father *Mersennus*: who is not content with advancing learning by his own industry and labours; but besides is alwayes (out of his generous affection to verity) inciting others to contribute to the publick stock of it.

He proposed to me likewise this following question, to wit,

why

why there is required a weight of water in double Geometrical proportion, to make a pipe run twice as faſt as it did, or to have twice as much water run out in the ſame time? Unto which I anſwer out of the ſame ground as before: That becauſe in running twice as faſt, there goeth out double water in every part of time; and again, every part of water goeth a double ſpace in the ſame part of time; that is to ſay, becauſe double the celerity is drawn into double the water, and double the water into double the celerity; therefore the preſent effect is to the former effect, as the effect or quadrate of a double line drawn into it ſelf, is to the effect or quadrate of half the ſaid line drawn into it ſelf. And conſequently the cauſe of the latter effect (which is the weight then) muſt be to the cauſe of the former effect (that is, to the former weight) in the ſame proportion; namely, as the quadrate of a double line, is to the quadrate of half that line. And ſo you ſee the reaſon of what he by experience findeth to be true. Though I doubt not but when he ſhall ſet out the Treatiſe which he hath made of this ſubject, the Reader will have better ſatisfaction.

In the mean while, an experience which *Galileo* delivereth will confirm this doctrine. He ſaith, that to make the ſame pendant go twice as faſt as it did, or to make every undulation of it in half the time it did; you muſt make the line at which it hangeth, double in Geometrical proportion to the line at which it hanged before. Whence it followeth, that the circle by which it goeth is likewiſe in double Geometrical proportion. And this being certain, that celerity to celerity hath the proportion of force, which weight hath to weight; it is evident, that as in one caſe there muſt be weight in Geometrical proportion; ſo in the other caſe, where onely celerity maketh the variance, the celerity muſt be in double Geometrical proportion, according as *Galileo* findeth it by experience.

But to return to our main intent, there is to be farther noted, that if the ſubject ſtrucken be of a proportionate ceſſibility, it ſeemeth to dull and deaden the ſtroke: whereas, if the thing ſtrucken be hard, the ſtroke ſeemeth to loſe no force, but to work a greater effect. Though indeed the truth be, that in both caſes the effects are equal; but diverſe according to the natures of the things that are ſtrucken; for no force that once is in nature can be loſt, but muſt have its adequate effect one way or other.

Let

Let us then first suppose the body strucken to be a hard body of no exceeding bigness: in which case, if the stroke light perpendicularly upon it, it will carry such a body before it. But if the body be too great, and have its parts so conjoyned, as that they are weaker than the stroke; in this case the stroke driveth one part before it, and so breaketh it from the rest. But lastly if the parts of the strucken body be so easily cessible, as without difficulty the stroke can divide them, then it entereth into such a body until it hath spent its force. So that now making up our account, we see that an equal effect proceedeth from an equal force in all the three cases; though in themselves they be far different. But we are apt to account that effect greater, which is more considerable unto us by the profit or damage it bringeth us. And therefore we usually say, that the blow which shaketh a wall, or beateth it down, and killeth men with the stones it scattereth abroad; hath a greater effect than that which penetrateth far into a mud wall, and doth little harm: for that innocuousness of the effect, maketh that although in it self it be as great as the other, yet it is little observed or considered.

12. When a movable cometh to rest, the motion doth decrease according to the rules of encrease.

This discourse draweth on another: which is, to declare how motion ceaseth. And to sum that up in short, we say that when motion cometh unto rest, it decreaseth and passeth through all the degrees of celerity and tardity that are between rest and the height of that motion which so declineth: and that in the proportion of the odd numbers, as we declared above, that it did encrease. The reason is clear: because that which maketh a motion cease, is the resistance it findeth: which resistance is an action of a mover that moveth something against the body which is moved, or something equivalent to such an action: wherefore it must follow the laws that are common to all motions: of which kinde those two are that we have expressed in this conclusion. Now that resistance is a countermotion, or equivalent to one, is plain by this; that any body which is pressed must needs presse again upon the body that presseth it; wherefore the cause that hindereth such a body from yielding, is a force moving that body against the body which presseth it. The particulars of all which we shall more at large declare, where we speak of the action and reaction of particular bodies.

CHAP.

CHAP. X.

Of Gravity and Levity; and of Local Motion, commonly termed Natural.

1. Those motions are called natural which have constant causes, & those violent which are contrary to them.

IT is now time to consider that distinction of motions which is so famous in *Aristotle*; to wit, that some motions are natural, others violent: and to determine what may be signified by these terms. For seeing we have said that no body hath a natural intrinsecal inclination unto any place, to which it is able to move it self; we must needs conclude that the motion of every body followeth the percussion of extrinsecal Agents. It seemeth therefore impossible that any body should have any motion natural to it self. And if there be none natural, there can be none violent. And so this distinction will vanish to nothing. But on the other side, living creatures do manifestly shew natural motions, having natural instruments to perform certain motions: wherefore such motions must of necessity be natural to them. But these are not the motions which we are to speak of; for *Aristotles* division is common to all bodies, or at the least to all those we converse withall: and particularly to those which are called heavy and light; which two terms passe through all the bodies we have notice of.

Therefore proceeding upon our grounds before layed; to wit, that no body can be moved of it self; we may determine those motions to be natural unto bodies which have constant causes, or percutients to make them alwaies in such bodies: and those violent which are contrary to such natural motions. Which being supposed, we must search out the causes that so constantly make some bodies descend towards the center or middle of the earth; and others to rise and go from the center: by which the world is subject to those restlesse motions, that keep all things in perpetual flux, in this changing sphear of action and passion.

2. The first and most general operation of the Sun, is the making and raising of atoms.

Let us then begin with considering what effects the Sunne (which is a constant and perpetuall cause) worketh upon inferiour bodies, by his being regularly sometimes present and sometimes absent. Observe in a pot of water hanging over a fire, how the heat maketh some parts of the water to ascend, and others to supply the room by descending, so that

that as long as it boyleth, it is in a perpetuall confused motion up and down. Now having formerly concluded that *fire is light, and light is fire*; it cannot be doubted but that the Sunne doth serve in stead of fire to our Glob of Earth and Water, (which may be fitly compared to the boyling pot;) and all the day long draweth vapours from those bodies that his beams strike upon. For he shooting his little darts of fire in multitudes, and in continued streams from his own center against the Python the Earth we live on; they do there overtake one another, and cause some degree of heat as farre as they sink in. But not being able (by reason of their great expansion in their long journey) to convert it into their own nature and set it on fire, (which requireth a high degree of condensation of the beams) they do but pierce and divide it very subtilly, and cut some of the outward parts of it into extreme little atom. Unto which they sticking very close, and being in a manner incorporated with them (by reason of the moisture that is in them) they do in their rebound back from the earth carry them along with them; like a ball that struck against a moist wall, doth in its return from it, bring back some of the mortar sticking upon it. For the distance of the earth from the Sun is not the utmost period of these nimble bodies flight; so that when by this solid body they are stopped in their course forwards on, they leap back from it, and carry some little parts of it with them: some of them a farther, some of them a shorter journey; according as their littleness and rarity make them fit to ascend. As is manifest by the consent of all Authors that write of the regions of the air; who determine the lower region to reach as far as the reflection of the Sun; and conclude this region to be very hot.

For if we mark how the heat of fire is greatest, when it is incorporated in some dense body; (as in Iron in Sea-Coal) we shall easily conceive that the heat of this region proceedeth mainly out of the incorporation of light with those little bodies which stick to it in its reflection. And experience testifieth the same, both in our soultry daies, which we see are of a gross temper, and ordinarily go before rain: as also in the hot springs of extreme cold countreys, where the first heats are unsufferable; which proceed out of the resolution of humidity congealed; & in hot

in hot windes (which the Spaniards call *Bochornos* from *Boca de horno* by alluſion to the breathing ſteam of an Oven when it is opened) which do manifeſtly ſhew that the heat of the Sun is incorporated in the little bodies, which compoſe the ſteam of that winde. And by the principles we have already layed, the ſame would be evident; though we had no experience to inſtruct us; for ſeeing that the body of fire is dry, the wet parts (which are eaſieſt reſolved by fire) muſt needs ſtick unto them, and accompany them in their return from the earth.

3. The light rebounding from the earth with atoms, cauſeth two ſtreams in the air; the one aſcending the other deſcending; and both of them in a perpendicular line.

Now whiles theſe aſcend, the air muſt needs cauſe others that are of a groſſer complexion to deſcend as faſt, to make room for the former, and to fill the places they left, that there may be no vacuity in nature. And to finde what parts they are and from whence they come, that ſucceed in the room of light and atoms glewed together that thus aſcend; we may take a hint from the maxim of the Opticks, that light reflecting maketh equal angles; whence, ſuppoſing the ſuperficies of the earth to be circular, it will follow that a perpendicular to the center paſſeth juſt in the middle between the two rayes; the incident and the reflected. Wherefore the air between theſe two raies, and ſuch bodies as are in it being equally preſſed on both ſides; thoſe bodies which are juſt in the middle, are neereſt and likelieſt to ſucceed immediately in the room of the light and atomes which aſcend from the ſuperficies of the Earth: and their motion to that point is upon the perpendicular. Hence it is evident, that the aire and all ſuch bodies as deſcend to ſupply the place of light and atomes, which aſcend from the Earth, do deſcend perpendicularly towards the center of the earth.

And again, ſuch bodies as by the force of light being cut from the Earth or Water, do not aſcend in form of light, but do incorporate a hidden light and heat within them; (and thereby are rarer than theſe deſcending bodies) muſt of neceſſity be lifted up by the deſcent of thoſe denſer bodies that go downwards, becauſe they (by reaſon of their denſity) are moved with a greater force. And this liſting up muſt be in a perpendicular line; becauſe the others deſcending on all ſides perpendicularly, muſt needs raiſe thoſe that are between them equally

equally from all sides: that is, perpendicularly from the center of the earth. And thus we see a motion set on foot, of some bodies continually descending, and others continually ascending: all in perpendicular lines, excepting those which follow the course of lights reflexion.

Again as soon as the declining Sun groweth weaker or leaveth our Horizon, and that his beams vanishing do leave the little horsemen which rode upon them, to their own temper and nature (from whence they forced them) they finding themselves surrounded by a smart descending stream, do tumble down again in the night, as fast as in the day they were carried up; and crowding into their former habitations, they exclude those that they finde had usurped them in their absence. And thus, all bodies within reach of the Suns power, but especially our air, are in perpetual motion; the more rarified ones ascending, and the dense ones descending.

4. A dense body placed in the air between the ascending and descending stream, must needs descend.

Now then, because no bodies wheresoever they be (as we have already shewed) have any inclination to move towards a particular place, otherwise than as they are directed and impelled by extrinsecal Agents: let us suppose that a body were placed at liberty in the open air. And then casting whether it would be moved from the place we suppose it in, and which way it would be moved; we shall finde that it must of necessity happen that it shall descend and fall down till it meet with some other grosse body to stay and support it. For although of it self it would move no way: yet if we finde that any other body striketh efficaciously enough upon it, we cannot doubt but that it will move that way which the striking body impelleth it. Now, it is strucken upon on both sides (above and below) by the ascending, and the descending atoms, the rare ones, striking upon the bottom of it, and driving it upwards, and the denser ones, pressing upon the top of it and bearing it downwards. But if you compare the impressions that the denser atoms make, with those that proceed from the rare ones; it is evident that the dense ones must be the more powerfull; and therefore will assuredly determine the motion of the body in the air, that way they go, which is downwards.

Nor need we fear, lest the littleness of the agents, or the feebleness of their strokes, should not be sufficient to work this

effect; since there is no resistance in the body it self, and the air is continually cut in pieces, by the Sun-beams, and by the motions of little bodies; so that the adhesion unto air of the body to be moved, will be no hinderance to this motion: especially, considering the perpetual new percussions, and the multitude of them, and how no force is so little, but that with time and multiplication it will overcome any resistance.

5. A more particular explication of all the former doctrine touching gravity.

But if any man desireth to look upon, as it were at one view, the whole chain of this doctrine of gravity: let him turn the first cast of his eyes upon what we have said of fire when we explicated the nature of it. To wit, that it beginneth from a little source; and by extreme multiplication and rarefaction, it extendeth it self into a great sphear. And then he will perceive the reason why light is darted from the body of the Sun with that incredible celerity, wherewith its beams fly to visit the remotest parts of the world; and how of necessity, it giveth motion to all circumstant bodies; since it is violently thrust forward by so extreme a rarefaction; and the farther it goeth, is still the more rarified and dilated.

Next, let him reflect how infinitely the quickness of lights motion, doth prevent the motion of a moist body, such an one as air is: and then he will plainly see, that the first motion which light is able to give unto the air, must needs be a swelling of that moist element, perpendicularly round about the earth; for, the ray-descendent, and the ray-reflectent, flying with so great a speed, that the air between them cannot take a formal ply any way before the beams of light be on both sides of it: it followeth, that according to the nature of humid things, it must first onely swell: for that is the beginning of motion in them, when heat entereth into them, and worketh upon them. And thus he may confidently resolve himself, that the first motion which light causeth in the air, will be a swelling of it between the two rays towards the middle of them; That is, perpendicularly from the surface of the earth.

And out of this, he will likewise plainly see, that if there be any other little dense bodies floating in the air, they must likewise mount a little, through this swelling and rising of the air. But that mounting will be no more than the immediate parts of the air themselves do move. Because this motion is not by way

of

of impulse or stroke that the air giveth those denser bodies; but by way of containing them in it, and carrying them with it, so that it giveth them no more celerity, than to make them go with it self, and as parts of it self.

Then, let him consider, that light or fire, by much beating upon the earth, divideth some little parts of it from others: whereof if any do become so small and tractable, as not to exceed the strength which the rayes have to manage them; the returning rayes, will at their going back, carry away with them or drive before them, such little atoms as they have made or meet with: and so fill the air with little bodies cut out of the earth.

After this, let him consider, that when light carrieth up an atom with it, the light and the atom do stick together, and do make one ascending body; in such sort as when an empty dish lyeth upon the water, the air in the dish maketh one descendent body together with the dish it self: so that the density of the whole body of air and dish (which in this case, are but as one body) is to be esteemed according to the density of the two parts; one of them being allayed by the other, as if the whole were throughout of such a proportion of density, as would arise out of the composition and kneading together the several densities of those two parts. Now then, when these little compounded bodies of light and earth, are carried up to a determinate height; the parts of fire or light, do by little and little break away from them: and thereby, the bulk of the part which is left, becometh of a different degree of density (quantity for quantity) from the bulk of the entire atom, when light was part of it: and consequently it is denser than it was.

Besides, let him consider that when these bodies ascend; they do go from a narrow room to a large one, that is, from the centerwards to the circumference: but when they come down again, they go from a larger part to a narrower. Whence it followeth, that as they descend, they draw closer and closer together, and by consequence, are subject to meet and to fall in one with another; and thereby to increase their bulk, and to become more powerfull in density; not onely, by the losse of their fire; but also by the encrease of their quantity. And so it is evident, that they are denser coming down, than going up.

Lastly, let him consider, that those atoms which went up first,

and are parted from their volatile companions of fire or light, must begin to come down apace, when other new atoms (which still have their light incorporated with them) do ascend to where they are, and do go beyond them by reason of their greater levity. And as the latter atoms come up with a violence and a great celerity, so must the first go down with a smart impulse: and by consequence, being more dense than the air in which they are carried, must of necessity cut their way through that liquid and rare *medium*; and go the next way to supply the defect and room of the atoms which ascend; (that is, perpendicularly to the earth) and give the like motion to any body they finde in their way, if it be susceptible of such a motion: which it is evident that all bodies are, unless they be strucken by some contrary impulse. For since that a bodies being in a *place*, is nothing else but the continuity of its outside to the inside of the body that containeth it and is its place, it can have no other repugnance to local motion (which is nothing else but a successive changing of place) besides this continuity. Now the nature of density, being the power of dividing; and every least power having some force and efficacy, (as we have shewed above) it followeth that the stroke of every atom (either descending, or ascending) will work something upon any body (though never so big) it chanceth to incounter with, and strike upon in its way, unless there be as strong an impulse the contrary way, to oppose it. But it being determined, that the descending atoms are denser than those that ascend; it followeth that the descending ones will prevail. And consequently, all dense bodies must necessarily tend downwards, to the center (which is, to be *Heavy*) if some other more dense body do not hinder them.

6. Gravity and levity do not signifie an intrinsecal inclination to such a motion in the bodies themselves which are termed heavy and light.

Out of this discourse, we may conclude that there is no such thing among bodies, as positive gravity or levity: but that their course upwards or downwards happeneth unto them by the order of nature, which by outward causes giveth them an impulse one of these waies: without which, they would rest quietly whersoever they are, as being of themselves indifferent to any motion. But because our words express our notions, and they are framed according to what appeareth unto us; when we observe any body to descend constantly towards our earth, we call it heavy; and if it move contrariwise, we call it light.

But

But we must take heed of considering such gravity and levity as if they were Entities that work such effects: since upon examination, it appeareth that these words are but short expressions of the effects themselves: the causes whereof, the vulgar of mankind (who impose names to things) do not consider; but leave that work unto Philosophers to examine; whiles they onely observe, what they see done; and agree upon words to express that. Which words neither will in all circumstances alwaies agree to the same thing; for as cork doth descend in air and ascend in water; so also will any body descend if it lighteth among others more rare than it self, and will ascend if it lighteth among bodies that are more dense than it. And we term bodies light and heavy, onely according to the course, which we usually see them take.

Now proceeding farther on, and considering how there are various degrees of density or gravity, it were irrational to conceive, that all bodies should descend at the same rate, and keep equal pace with one another, in their journey downwards. For as two knifes whereof one hath a keener edge than the other, being pressed with equal strength into like yielding matter, the sharper will cut deeper than the other: so, if of two bodies one be more dense than the other, that which is so, will cut the air more powerfully, and will descend faster than the other: for in this case density may be compared to the knifes edge, since in it consisteth the power of dividing; as we have heretofore determined. And therefore, the pressing them downwards by the descending atoms, being equal in both (or peradventure greater in the more dense body, as anon we shall have occasion to touch) and there being no other cause to determine them that way; the effect of division must be the greater, where the divider is the more powerfull. Which, the more dense body is; and therefore cutteth more strongly through the resistance of the air; and consequently, passeth more swiftly that way it is determined to move.

7. The more dense a body is, the more swiftly it descendeth.

8. The velocity of bodies descending, doth not increase in proportion to the difference that may be between their several densities.

I do not mean, that the velocities of their descent shall be in the same proportion to one another, as their densities are: for besides their density, those other considerations which we have discoursed of above when we examined the causes of velocity in motion, must likewise be ballanced. And out of the com-

comparison of all them; not out of the consideration of any one alone, resulteth the differences of their velocities: (and that neither, but in as much as concerneth the consideration of the movables: for to make the calculation exact, the *medium* must likewise be considered; as by and by we shall declare) for since the motion dependeth of all them together; although there should be difference between the movables in regard of one only, and that the rest were equal; yet the proportion of the difference of their motions, must not follow the proportion of their difference in that one regard: because their difference considered single in that regard will have one proportion; and with the addition of the other considerations (though alike in both) to their difference in this, they will have another.

As for example, reckon the density of one movable to be double the density of another movable; so that in that regard it hath two degrees of power to descend, whereas the other hath but one: suppose then the other causes of their descent to be alike in both, and reckon them all three: and then joyn these three to the one which is caused by the density in one of the movables, as likewise to the two, which is caused by the density in the other movable, and you will finde that thus altogether, their difference of power to descend is no longer in a double proportion (as it would be, if nothing but their density were considered) but is in the proportion of five to four.

But after we have considered all that concerneth the movables, we are then to cast an eye upon the *medium* they are to move in; and we shall finde the addition of that, to decrease the proportion of their difference, exceedingly more; according to the cessibility of the *medium*. Which if it be air; the great disproportion of its weight, to the weight of those bodies which men use to take in making experiences of their descent in that yielding *medium*, will cause their difference of velocity in descending, to be hardly perceptible. Even as the difference of a sharp or dull knife, which is easily perceived in cutting of flesh or bread, is not to be distinguished in dividing of water or oyl. And likewise in weights, a pound and a scruple will bear down a dramme in no sensible proportion of velocity more than a pound alone would do: and yet put a pound in that scale in stead of the dramme, and then the

the difference of the scruple will be very notable. So then, those bodies, whose difference of descending in water is very sensible (because of the greater proportion of weight in water, to the bodies that descend in it) will yield no sensible difference of velocity when they descend the air, by reason of the great disproportion of weight between air and the bodies that descend in it.

The reason of this will clearly shew it self in abstracted proportions. Thus, suppose air to have one degree of density, and water to have 400; then let the movable A have 410 degrees of density; and the movable B have 500. Now compare their motion to one another in the several *mediums* of air and water. The exuperance of the density of A to water is 10 degrees, but the exuperance of B unto the same water, is 100 degrees; so that B must move in water swifter than A, in the proportion of 100 to ten; that is, of 10 to one. Then let us compare the exuperance of the two movables over air. A is 409 times more dense than air; but B is 499 times more dense than it. By which account, the motion of B, must be in that *medium* swifter than the motion of A, in the proportion of 499 to 409 times: that is, about 50. to 41: which (to avoid fractions) we may account as 10 to 8. But in water they exceed one another as 10 to one: so that their difference of velocity must be scarce perceptible in air in respect of what it is in water.

Out of all which discourse, I only infer in common, that a greater velocity in motion, will follow the greater density of the movable; without determining here their proportions: which I leave unto them, who make that examination their task: for thus much serveth my present turn: wherein I take a survey of nature, but in gross. And my chief drift in this particular is only to open the way for the discovering how bodies that of themselves have no propension unto any determinate place; do nevertheless move constantly and perpetually one way; the dense ones descending, and the rare ones ascending: not by any intrinsecal quality that worketh upon them; but by the œconomy of nature, that hath set on foot due and plain causes to produce known effects.

9. More or less gravity doth produce a swifter or a slower de-

Here we must crave patience of the great soul of *Galileus* (whose admirable learning all posterity must reverence) whiles we reprehend in him, that which we cannot term less than

ſcending of a heavy body. Ariſtotles argument to diſprove motion *in vacuo*, is made good.

abſurd: and yet, he not onely maintaineth it in ſeveral places, but alſo profeſſeth, *Dial. F°. de motu, pag.* 81. to make it more clear than day. His poſition is, that more or leſs gravity contributeth nothing at all to the faſter or ſlower deſcending of a natural body: but that all the effect it giveth unto a body, is to make it deſcend or not deſcend in ſuch a *medium*. Which is againſt the firſt and moſt known principle that is in bodies: to wit, that more doth more, and leſs doth leſs; for he alloweth, that gravity cauſeth a body to deſcend; and yet will not allow, that more gravity cauſeth it to deſcend more.

I wonder that he never marked how in a pair of ſcales, a ſuperproportion of overweight in one ballance, lifted up the other faſter than a leſs proportion of overweight would do. Or that more weight hanged to a jack, made the ſpit turn faſter; or to the lines of a clock, made it go faſter, and the like.

But his argument whereby he endeavoreth to prove his poſition, is yet more wonderful: for finding in pendants unequal in gravity, that the lighter went in the ſame time almoſt as faſt as the heavier; he gathereth from thence, that the different weights have each of them the ſame celerity: and that it is the oppoſition of the air, which maketh the lighter body not reach ſo far at each undulation, as the heavier doth. For reply whereunto; firſt, we muſt ask him whether experience or reaſon taught him, that the ſlower going of the lighter pendant, proceeded onely from the *medium*, and not from want of gravity? And when he ſhall have anſwered (as he needs muſt) that experience doth not ſhew this; then we muſt importune him for a good reaſon: but I do not finde that he bringeth any at all.

Again, if he admitteth (which he doth in expreſs terms) that a lighter body cannot reſiſt the *medium* ſo much as a heavier body can, we muſt ask him, whether it be not the weight that maketh the heavier body reſiſt more: which when he hath acknowledged that it is; he hath therein likewiſe acknowledged, that whenſoever this happeneth in the deſcending of a body, the more weight muſt make the heavier body deſcend faſter.

But we cannot paſſe this matter without noting how himſelf maketh good thoſe arguments of *Ariſtotle*, which he ſeemeth by no means to eſteem of: for ſince the gravity doth overcome the reſiſtance of the *medium* in ſome proportion; it followeth, that the

the proportions between the gravity and the *medium*, may be multiplied without end; so as, if he suppose that the gravity of a body do make it go at a certain rate in imaginary space, (which is his manner of putting the force of gravity,) then there may be given such a proportion of a heavy body to the *medium*, as it shall go in such a *medium* at the same rate; and nevertheless, there will be an infinite difference, betwixt the resistance of the *medium* compared to that body, and the resistance of the imaginary space compared to that other body which he supposeth to be moved in at the same rate: which no man will stick at confessing to be very absurd.

Then turning the scales, because the resistance of the *medium* doth somewhat hinder gravity, and that with less resistance the heavy body moveth faster; it must follow, that since there is no proportion, betwixt the *medium* and imaginary space; there must neither be any proportion betwixt the time in which a heavy body shall passe through a certain quantity of the *medium*, and the time in which it shall passe through as much imaginary space: wherefore, it must passe over so much imaginary space in an instant. Which is the argument that *Aristotle* is so much laughed at for pressing. And in a word nothing is more evident, than that for this effect which *Galileo* attributeth to gravity, it is unreasonable to put a divisible quality, since the effect is indivisible. And therefore as evident it is that in his doctrine such equality, as intrinsecal gravity is conceived to be, ought not to be put: since every power should be fitted to the effect, or end for which it is put.

Another argument of *Galileo* is as bad as this; when he endeavoureth to prove that all bodies go of a like velocity, because it happeneth that a lighter body in some case, goeth faster than a heavier body in another case: as for example, in two pendants, whereof the lighter is in the beginning of its motion, and the heavier towards the end of it; or if the lighter hangeth at a longer string, and the heavier at a shorter; we see that the lighter will go faster than the heavier. But this concludeth no more, than if a man should prove that a lighter goeth faster than a heavier, because a greater force can make it go faster; for it is manifest, that in a violent motion, the force which moveth a body in the end of its course, is weaker than that which moveth it in the beginning: and the like is, of the two strings. But

10. The reason why at the inferior quarter of a circle, a body doth descend faster by the arch of that quarter, than by the chord of it.

But here it is not amisse to solve a Problem he putteth which belongeth to our present subject. He findeth by experience, that if two bodies descend at the same time from the same point, and do go to the same point, the one by the inferior quarter of the circle; the other by the chord to that arch, or by any other lines which are chords to parts of that arch: he findeth (I say) that the movable goeth faster by the arch, than by any of the chords. And the reason is evident, if we consider that the neerer any motion doth come unto a perpendicular one downwards, the greater velocity it must have: and that in the arch of such a quadrant, every particular part of it inclineth to the perpendicular of the place where it is, more than the part of the chord answerable unto it doth.

CHAP. XI.

An answer to objections against the causes of natural motion, avowed in the former Chapter; and a refutation of the contrary opinion.

1. The first objection answered; why a hollow body descendeth slower than a solid one.

BUt to return to the thrid of our doctrine; there may peradventure be objected against it, that if the violence of a bodies descent towards the center, did proceed onely from the density of it (which giveth it an aptitude, the better to cut the *medium*) and from the multitude of little atoms descending that strike upon it, and press it the way they go; which is downwards: then it would not import whether the inner part of that body were as solid as the outward parts; for it cutteth with onely the outward, and is smitten onely upon the outward. And yet experience sheweth us the contrary: for a great bullet of lead, that is solid and lead throughout, descendeth faster than if three quarters of the diameter were hollow within; and such a one falling upon any resisting substance, worketh a greater effect than a hollow one. And a ball of brass that hath but a thin outside of metal will swim upon the water, when a masse one sinketh presently. Whereby it appeareth, that it is rather some other quality belonging to the very bulk of the metal in it self; and not these outward causes that occasion gravity.

But this difficulty is easily overcome, if you consider how subtile those atoms are which descending downwards and striking

ing upon a body in their way, do cause its motion likewise downwards: for you may remember how we have shewed them to be the subtilest and the minutest divisions that *light*, the subtilest and sharpest divider in nature, can make. It is then easie to conceive that these extreme subtile bodies do penetrate all others, as light doth glass; and do through run them, as sand doth through a small sieve, or as water through a spunge; so that they strike, not onely upon the superficies, but as well in every most interior part of the whole body; running quite through it all, by the pores of it. And then, it must needs follow that the solider it is, and the more parts it hath within (as well as without) to be strucken upon, the faster it must go, and the greater effect it must work in what it falleth upon: whereas if three quarters of the diameter of it within, should be filled with nothing but with air, the atoms would fly without any considerable effect through all that space, by reason of the rarity and cessibility of it.

And that these atoms are thus subtile; is manifest by several effects which we see in nature. Divers Authors that write of *Egypt* do assure us, that though their houses be built of strong stone; nevertheless, a clod of earth laid in the inmost rooms, and shut up from all appearing communication with air, will encrease its weight so notably, as thereby they can judge the change of weather, which will shortly ensue. Which can proceed from no other cause, but from a multitude of little atoms of saltpeter, which floating in the air, do penetrate through the strongest walls, and all the massie defences in their way, and do settle in the clod of earth as soon as they meet with it; because it is of a temper fit to entertain, and to conserve, and to embody them. Delights have shewed us the way, how to make the spirits or atoms of snow and saltpeter passe through a glass vessel; which Alchimists hold to be the most impenetrable of all they can finde to work with. In our own bodies; the aches which feeble parts do feel before change of weather, and the heavinesse of our heads and shoulders, if we remain in the open air presently after Sun-set; do abundantly testifie, that even the grosser of these atoms (which are the first that fall) do vehemently penetrate our bodies: so as, sense will make us believe, what reason peradventure could not.

But besides all this, there is yet a more convincing reason, why the

the descending atoms should move the whole density of a body, even though it were so dense that they could not penetrate it, and get into the bowels of it, but must be content to strike barely upon the outside of it. For nature hath so ordered the matter, that when dense parts stick close together, and make the length composed of them to be very stiff; one cannot be moved but that all the rest (which are in that line) must likewise be thereby moved: so that if all the world were composed of atoms close sticking together, the least motion imaginable must drive on all that were in a straight line, to the very end of the world. This you see is evident in reason, and experience confirmeth it, when by a little knock given at the end of a long beam, the shaking (which maketh sound) reacheth sensibly to the other end. The blinde man that governeth his steps by feeling in defect of eyes, receiveth advertisements of remote things through a staff which he holdeth in his hands, peradventure more particularly than his eyes could have directed him. And the like is of a deaf man that heareth the sound of an instrument, by holding one end of a stick in his mouth, whiles the other end resteth upon the instrument. And some are of opinion (and they not of the rank of vulgar Philosophers) that if a staff were as long as to reach from the Sun to us, it would have the same effect in a moment of time. Although for my part I am hard to believe that we could receive an advertisement so far, unless the staff were of such a thickness as being proportionable to the length might keep it from facile bending: for if it should be very pliant it would do us no service: as we experience in a thrid, which reaching from our hand to the ground, if it knock against any thing, maketh no sensible impression in our hand.

So that in fine, reason, sense, and authority do all of them shew us, that the less the atoms should penetrate into a moving body, by reason of the extreme density of it, the more efficaciously they would work, and the greater celerity they would cause in its motion. And hence we may give the fullest solution to the objection above, which was to this effect: that seeing division is made onely by the superficies or exterior part of the dense body; and that the virtue whereby a dense body doth work, is onely its resistance to division; which maketh it apt to divide: it would follow, that a hollow bowl of brass or iron should be as hea-

heavy as a solid one. For we may answer, that seeing the atoms must strike through the body; and that a cessible body doth not receive their strokes so firmly as a stiff one; nor can convey them so far: if unto a stiff superficies there succeed a yielding inside, the strokes must of necessity lose much of their force; and consequently, cannot move a body full of air with so much celerity, or with so much efficacy as they may a solid one.

3. The second objection answered, and the reasons shown why atoms do continually overtake the descending dense body.

But then you may peradventure say, that if these strokes of the descending atoms upon a dense body, were the cause of its motion downwards, we must allow the atoms to move faster than the dense body; that so they may still overtake it and drive it along, and enter into it: whereas if they should move slower than it, none of them could come in their turn to give it a stroke, but it would be past them, and out of their reach before they could strike it. But it is evident (say you) out of these pretended causes of this motion, that such atoms cannot move so swiftly downwards, as a great dense body; since their littleness and their rarity, are both of them hindering to their motion: and therefore this cannot be the cause of that effect which we call gravity.

To this I reply; That to have the atoms give these blows to a descending dense body, doth not require that their natural and ordinary motion should be swifter than the descent of such a dense body: but the very descent of it occasioneth their striking it; for as it falleth and maketh it self a way through them, they divide themselves before it, and swell on the sides, and a little above it, and presently close again behinde it and over it assoon as it is past. Now that closing to hinder vacuity of space is a sudden one, and thereby attaineth great velocity; which would carry the atoms in that degree of velocity farther than the descending body, if they did not encounter with it in their way to retard them: which encounter and retarding implyeth such strokes upon the dense body as we suppose to cause this motion. And the like we see in water, into which letting a stone fall, presently the water that was divided by the stone, and swelleth on the sides higher than it was before, closeth upon the back of the descending stone, and followeth it so violently, that for a while after it leaveth a purling hole in the place where the stone went down, till by the repose of the stone, the water returneth likewise to its quiet; and so its superficies becometh even.

In

3. A curious question left undecided.

In the third place, an enquiry occurreth emergent out of this doctrine, of the cause of bodies moving upwards and downwards. Which is, Whether there would be any natural motion deep in the earth, beyond the activity of the Suns beams? for out of these principles it followeth that there would not: and consequently there must be a vast orb in which there would be no motion of gravity or of levity: for suppose that the Sun beams might pierce a thousand miles deep into the body of the Earth; yet there would still remain a masse, whose diameter would be neer 5000 miles, in which there would be no gravitation nor the contrary motion.

For my part, I shall make no difficulty to grant the inference, as far as concerneth motion caused by our Sun: for what inconvenience would follow out of it? But I will not offer at determining whether there may not be enclosed within that great sphear of Earth, some other fire, (such as the Chymists talk of) an Archeus, a Demogorgon seated in the center, like the heart in animals, which may raise up vapours and boyl an air out of them, and divide gross bodies into atoms; and accordingly give them motions answerable to ours, but in different lines from ours, according as that fire or Sun is situated; since the far-searching Author of the Dialogues *de Mundo*, hath left that speculation undecided, after he had touched upon it in the twelfth knot of his first Dialogue.

4. The fourth objection answered; Why the descent of the same heavy bodies is equal in so great inequality of the atoms which cause it.

Fourthly, it may be objected, that if such descending atoms as we have described were the cause of a bodies gravity, and descending towards the center; the same body would at divers times descend more and lesse swiftly; for example, after midnight when the atoms begin to descend more slowly; then likewise the same body would descend more slowly in a like proportion, and not weigh so much as it did in the heat of the day. The same may be said of Summer and Winter: for in Winter time the atoms seem to be more grosse; and consequently to strike more strongly upon the bodies they meet with in their way as they descend: yet on the other side, they seem in the Summer to be more numerous, as also to descend from a greater height; both which circumstances will be cause of a stronger stroke and more vigorous impulse upon the body they hit. And the like may be objected of divers

parts

parts of the world, for in the Torrid Zone it will alwaies happen as in Summer in places of the temperate Zone; and in the Polar climes as in deepest Winter: so that no where there would be any standard or certainty in the weight of bodies, if it depended upon so mutable a cause. And it maketh to the same effect, that a body which lieth under a thick Rock, or any other very dense body, that cannot be penetrated by any great store of atoms; should not be so heavy as it would be in the open and free air, where the atoms in their compleat numbers have their full strokes.

For answer to these and such like instances; we are to note first, that it is not so much the number or the violence of the percussion of the striking atomes, as the density of the thing strucken, which giveth the measure to the descending of a weighty body: and the chief thing which the stroke of the atomes giveth unto a dense body, is a determination of the way which a dense body is to cut unto it self: therefore multiplication or lessening of the atomes, will not make any sensible difference betwixt the weight of one dense body where many atomes do strike, and another body of the same density where but a few do strike; so that the stroke downwards of the descending atomes, be greater than the stroke upwards of the ascending atomes; and thereby determineth it to weigh to the centerwards, and not rise floating upwards, which is all the sensible effect we can perceive.

Next we may observe, that the first particulars of the objection, do not reach home to enfeeble our doctrine in this particular, although we admit them to be in such sort as they are proposed: for they do withall imply such a perpetuall variation of causes, ever favourable to our position, that nothing can be inferred out of them to repugne against it. As thus: When there are many atoms descending in the air, the same general cause which maketh them be many, maketh them also be light in proportion to their multitude. And so, when they are few they are heavy; likewise when the atoms are light, the aire is rarified and thinne; and when they are heavy the aire is thick; and so upon the whole matter it is evident, that we cannot make such a precise and exact judge-

ment

ment of the variety of circumstances, as to be able to determine when there is absolutely more cause of weight, and when less. And as we finde not weight enough in either side of these opposite circumstances to turn the scales in our discourse, so likewise we find the same indifference in experience it self: for the weights we use do weigh equally in misty weather and in clear: and yet in rigor of discourse, we cannot doubt but that in truth they do not gravitate or weigh so much (though the difference be imperceptible to sense) when the air is thick and foggy, as when it is pure and rarified: which thickness of the *medium*, when it arriveth to a very notable degree, as for example to water, maketh then a great difference of a heavy bodies gravitation in it; and accordingly we see a great difference between heavy bodies descending in water and in air; though between two kindes of air none is to be observed, their difference is so small in respect of the density of the body that descendeth in them. And therefore, seeing that an assured and certain difference in circumstances maketh no sensible inequality in the effect; we cannot expect any from such circumstances as we may reasonably doubt whether there be any inequality among them or no.

Besides that, if in any of the proposed cases a heavy body should gravitate more, and be heavier one time than another; yet by weighing it, we could not discern it; since that the counterpoise (which is to determine its weight) must likewise be in the same proportion heavier than it was. And besides weighing, no other means remaineth to discover its greater gravitation, but to compare it to time in its descent: and I believe that in all such distances as we can try it in, its inequalities will be no whit less difficult to be observed that way, than any other.

5. The reason why the shelter of a thick body doth not hinder the descent of that which is under it.

Lastly, to bend our discourse particularly to that instance of the objection; where it is conceived that if gravity or descending downwards of bodies proceeded from atoms striking upon them as they move downwards; it would follow, that a stone or other dense body lying under shelter of a thick, hard, and impenetrable adamantine rock, would have no impulse downwards, and consequently would not weigh there. We may note, that no body whatsoever compacted by Physical causes and agents, can be so dense and imporous, but that such

such atoms, as these we speak of, must be in them, and in every part of them, and every where pass through and through them; as water doth through a sieve or through a spunge: and this universal maxime must extend as far as the sun, or as any other heat communicating with the sun doth reach and is found.

The reason whereof is, because these atoms are no other thing, but such extreme little bodies as are resolved by heat, out of the main stock of those massie bodies upon which the sun and heat do work. Now then it being certain, out of what we have heretofore said, that all mixt bodies have their temper and consistence, and generation, from the mingling of fire with the rest of the Elements that compose them; and from the concoction or digestion which fire maketh in those bodies, it is evident, that no mixt body whatsoever, nor any sensible part of a mixt body, can be void of pores capable of such atoms, nor can be without such atoms passing through those pores; which atoms by mediation of the air (that likewise hath its share in such pores) must have communication with the rest of the great sea of air, and with the motions that pass in it. And consequently, in all and every sensible part, of any such extreme dense, and pretended impenetrable body, (to the notice whereof we can arrive) this percussion of atoms must be found; and they will have no difficulty in running through; nor by means of it, in striking any other body lying under the shelter of it; and thus both in & from, that hard body, there must be still an uninterrupted continuation of gravity, or of descending towards the center.

Unto which we may add, that the stone or dense body cannot lie so close to the rock that covereth it, but that some air must be between, (for if nothing were between, they would be united, and become one continued body;) and in that air (which is a creek of the great ocean of air spred over the world, that is every where bestrewed with moving atoms; and which is continually fed, like a running stream, with new air that driveth on the air it overtaketh) there is no doubt but there are descending atoms, as well as in all the rest of its main body: and these descending atoms meeting with the stone, must needs give some stroke upon it; and that stroke (be it never so little) cannot chuse but work some effect, in making the stone remove a little that

way they go; and that motion, whereby the space is enlarged, between the stone and the sheltering rock, must draw in a greater quanity of air and atoms to strike upon it. And thus by little and little, the stone passeth through all the degrees of tardity by which a descending body parteth from rest: which is by so much the more speedily done, by how much the body is more eminent in density. But this difference of time, in regard of the atoms strokes onely; and abstracting from the bodies density; will be insensible to us; seeing (as we have said) no more is required of them, but to give a determination downwards.

6. The reason why some bodies sink, others swim.

And out of this, we clearly see the reason why the same atoms, striking upon one body lying upon the water, do make it sinke; and upon another they do not. As for example, if you lay upon the superficies of some water, a piece of iron, and a piece of cork, of equal bigness and of the same figure; the iron will be beaten down to the botome, and the cork will float at the top. The reason whereof is, the different proportions of the comparison of their densities with the density of water: for (as we have said) the efficacy and force of descending, is to be measured by that. So then the strokes of the atoms, being more efficacious upon water than upon cork, because the density of water is greater than the density of cork, considering the abundance of air that is harboured in the large pores of it; it followeth, that the atoms will make the water go down more forcibly than they will cork. But the density of iron exceeding the density of water, the same strokes will make the iron descend faster than the water; and consequently, the iron must sinke in the water, and the cork will swim upon it.

And this same is the cause, why if a piece of cork be held by force at the bottom of the water; it will rise up to the top of the water, as soon as the violence is taken away that kept it down: for the atoms strokes having more force upon the water than upon the cork, they make the water sink and slide under it; first, a little thin plate of water; and then another a little thicker; and so by degrees more and more, till it hath lifted the cork quite up to the top.

7. The fifth objection answered concer-

Fifthly, it may be objected, that these atoms do not descend alwaies perpendicularly, but some times slopingly; and in that case, if their strokes be the cause of dense bodies moving, they should

should move sloping, and not downward. Now that these atoms descend sometimes slopingly, is evident, as when (for example) they meet with a stream of water, or with a strong wind, or even with any other little motion of the air, such as carrieth feathers up and down hither and thither; which must needs waft the atoms in some measure along with them their way; seeing then that such a gentle motion of the air is able to put a feather out of its way, notwithstanding the percussions of the atoms upon it; why shall it not likewise put a piece of iron out of its way downwards; since the iron hath nothing from the atoms but a determination to its way? But much more, why should not a strong wind, or a current of water, do it; since the atoms themselves that give the iron its determination must needs be hurried along with them?

ning the descending of heavie bodies in streams.

To this we answer, that we must consider, how any wind or water which runneth in that sort, is it self originally full of such atoms; which continually, and every where, press into it and cut through it, in pursuing their constant perpetual course of descending; in such sort, as we shewed in their running through any hard rock, or other densest body. And these atoms do make the wind or the water primarily tend downwards; though other accidental causes impel them secondarily to a sloping motion. And still, their primary natural motion will be in truth strongest; though their not having scope to obey that, but their having enough to obey the violent motion, maketh this become the more observable. Which appeareth evidently out of this; that if there be a hole in the bottom of the pipe that conveyeth water slopingly, be the pipe never so long, and consequently the sloping motion never so forcible; yet the water will run out at that hole to obey its more powerfull impulse to the centerwards, rather than continue the violent motion, in which it had arrived to a great degree of celerity.

Which being so, it is easie to conceive that the atoms in the wind or water which move perpendicularly downwards, will still continue the irons motion downwards, notwithstanding the mediums sloping motion: since the prevailing force determineth both the iron, and the medium downwards; and the iron hath a superproportion of density to cut its way, according as the prevalent motion determineth it.

But if the descending atoms be in part carried along down the stream by the curent of wind or water; yet still the current bringeth with it new atoms into the place of those that are carried away; and these atoms, in every point of place wheresoever they are, do of themselves tend perpendicularly downwards; howbeit they are forced from the complete effect of their tendance, by the violence of the current: so that in this case they are moved by a declining motion, compounded of their own natural motion, and of the forced motion, with which the stream carrieth them. Now then if a dense body do fall into such a current where these different motions give their several impulses, it wil be carried (in such sort as we say of the atoms; but in another proportion) not in a perpendicular but in a mixt declining line, compounded out of the several impulses, which the atoms and the current do give it (in which also it is to be remembred, how the current giveth an impulse downwards, as well as sloping; and peradventure the strongest downwards:) and the declinasion will be more or less, according as the violent impulse prevaileth more or less aganst the natural motion.

But this is not all that is to be considered in estimating the declination of a dense bodies motion when it is sinking in a current of wind or water; you must remember that the dense body it self hath a particular virtue of its own (namely its density) by which it receiveth and prosecuteth more fully its determination downwards; and therefore the force of that body in cutting its way through the medium, is also to be considered in this case, as well as above, in calculating its declining from the perpendicular; & out of all these causes will result a middle declination compounded of the motian of the water or wind both waies, and of its own motion by the perpendicular line. And since of these three causes of a dense bodies motion, its own virtue in prosecuting by its density the determination it requireth, is the most efficacious by much after it hath once received a determination from without; its declination will be but little if it be very dense and heavie: But if it recede much from density, so as to have some neare proportion to the density of the medium, the declination will be great. And in a word, according as the body is heavier or lighter, the declination will be more or less, in the same curreut though not exactly

exactly according to the proportion of the diminishing of its density, as long as there is a superproportion of its density to the medium: since that such a superproportion (as we have declared heretofore) maketh the mediums operation upon the dense body scarce considerable.

And hence you see why a stone or piece of iron, is not carried out of its way as well as a feather; because the stones motion downwards is greater and stronger than the motion of a feather downwards. And by consequence, the force that can deturn a feather from its course downwards, is not able to deturn a stone. And if it be replied, that it may be so ordered that the stone shall have no motion, before it be in the stream of a river, and notwithstanding it will still move downwards: we may answer, that considering the little declivity of the bed of such a stream, the strongest motion of the parts of the stream, must necessarily be downwards; and consequently, they will beat the stone downwards. And if they do not the like to a feather or other light body; it is because other parts of the stream, do get under the light body, and beat it upwards, which they have not power enough to do to the stone.

Sixthly, it may be objected, that if Elements do not weigh in their own spheres; then their gravity and descending must proceed from some other cause, and not from this percussion of the atoms we attribute to it; which percussion we have determined goeth through all bodies whatsoever, and beateth upon every sensible Part of them. But that Elements weigh not in their own spheres, appeareth out of the experience of a syphon; for though one leg of a syphon, be sunk never so much deeper into the body of the water, than the other leg reacheth below the superficies of the water: nevertheless, if once the outward leg become full of water, it will draw it out of the other longer leg: which it should not do, if the parts of water that are comprised within their whole bulk, did weigh; seeing that the bulk of water is much greater in the sunk leg than in the other, and therefore these should rather draw back the other water into the cistern, than be themselves drawn out of it into the air.

8. The sixth objection answered: and that all heavy elements do weigh in their own spheres.

To this we answer, that it is evident the Elements do weigh in their own spheres; at least as far as we can reach to their spheres:

for we see that a bottome stuffed hard with air is heavier than an empty one. Again, more water would not be heavier than less if the inward parts of it did not weigh: and if a hole were digged in the bottome of the sea, the waters would not run into it and fill it, if it did not gravitate over it. Lastly, there are those who undertake to distinguish in a deep water, the divers weights which several parts of it have, as they grow still heavier and heavier towards the bottom: and they are so cunning in this art, that they profess to make instruments which by their equality of their weight to a determinate part of the water, shall stand just in that part, and neither rise nor fall higher or lower: but if it be put lower, it shall ascend to its exact equally weighing orbe of the water; and if be put higher, it shall descend until it cometh to rest precisely in that place. Whence it is evident, that parts of water do weigh within the bulk of their main body; and of the like we have no reason to doubt, in the other two weighty Elements.

As for the opposition of the syphon, we refer that point to where we shall have occasion to declare the nature of that engine, of set purpose. And there wee shall shew, that it could not succeed in its operation, unless the parts of water did gravitate in their main bulk, into which one leg of the syphon is sunk.

9. The seventh objection answered, and the reason why we do not feel the course of the air and atoms that beat continually upon us.

Lastly, it may be objected, that if there were such a course of atoms as we say; and that their strokes were the cause of so notable an effect, as the gravity of heavy bodies; we should feel it palpably in our own bodies, which experince sheweth us we do not.

To this we answer first, that there is no necessity we should feel this course of atoms, since by their subtilty they penetrate all bodies; and consequently, do not give such strokes as are sensible. Secondly, if we consider that dusts and straws, and feathers do light upon us without causing any sense in us; much more we may conceive that atoms (which are infinitely more subtile and light) cannot cause in us any feeling of them. Thirdly, we see that what is continual with us, and mingled in all things, doth not make us take any especial notice of it: and this is the case of the smiting of atoms. Nevertheless peradventure we feel them in truth, as often as we feel hot and cold weather, and in all catarres or other such changes, which do as it were

sink

sink into our body without our perceiving any sensible cause of them: for no question but these atoms are the immediate causes of all good and bad qualities in the air. Lastly, when we consider that we cannot long together hold out our arm at length, or our foot from the ground, and reflect upon such like impotencies of our resisting the gravity of our own body: we cannot doubt but that in these cases we feel the effect of these atoms, working upon those parts; although we cannot by our sense discern immediately that these are the causes of it.

10. How in the same body, gravity may be greater than density, and density than gravity; though they be the same thing.

But now it is time to draw our Reader out of a difficulty, which may peradventure have perplexed him in the greatest part of what he hath hitherto gone over. In our investigation of the Elements, we took for a principle thereunto, That gravity is sometimes more, sometimes less, than the density of the body in which it is. But in our explication of rarity and density, and again in our explication of gravity, we seem to put that gravity and density is all one. This (them I apprehend, may in all this distance have put some to pain: but it was impossible for me to remedy it; because I had not yet delivered the manner of gravitation. Here then I will do my best, to assuage their grief, by reconciling these appearing repugnancies.

We are therefore to consider, that density (in it self) doth signifie a difficulty to have the parts of its subject, in which it is, separated one from another; and that gravity (likewise in it self) doth signifie a quality, by which a heavy body doth descend towards the center; or (which is consequent thereunto) a force to make an other body descend. Now this power, we have shewed, doth belong unto density, so far forth as a dense body being strucken by another, doth not yield by suffering its parts to be divided; but with its whole bulk striketh the next before it, and divideth it, if it be more divisible than it self is. So that you see density hath the name of density, in consideration of a passive quality, or rather of an impassibility which it hath; and the same density is called gravity, in respect of an active quality it hath which followeth this impassibility. And both of them are estimated by the different respects which the same body or subject, in which they are, have unto different bodies that are the terms whereunto it is compared: for the active quality or gravity of a dense body is esteemed by its respect to the body it striketh upon; whereas its

denſity includeth a reſpect ſingly to the body that ſtriketh it.

Now it is no wonder that this change of compariſon worketh a diſparity in the denominations: and that thereby the ſame body may be conceived to be more or leſs impartible, than it is active or heavy. As for example, let us of a denſe Element take any one leaſt part, which muſt of neceſſity be in its own nature and kind abſolutely impartible: and yet it is evident that the gravity of this part muſt be exceeding little by reaſon of the littleneſs of its quantity; ſo that thus you ſee an extremity of the effect of denſity, joyned together in one body (by the accident of the littleneſs of it) with a contrary extremity of the effect of gravity, (or rather with the want of it) each of them within the limits of the ſame ſpecies. In like manner it happeneth, that the ſame body in one circumſtance is more weighty, in another (or rather in the contrary) is more partible: ſo water when it is in a pail, becauſe it is thereby hindered from ſpreading abroad, hath the effect of gravity predominating in it; but if it be powred out, it hath the effect of partibility more. And thus it happeneth that merely by the gradation of rarity and denſity, one denſe body may be apt, out of the general courſe of natural cauſes, to be more diviſible than to be a divider; though according to the nature of the degrees conſidered abſolutely in themſelves, what is more powerfull to divide, is alſo more reſiſtent and harder to be divided. And this arriveth in that degree which maketh water; for the falling and beating of the atoms upon water, hath the power both to divide it and to make it deſcend; but ſo, that by making it deſcend it divideth it. And therefore we ſay, that it hath more gravity than denſity, though it be the very denſity of it, which is the cauſe that maketh it partible, by the working of one part upon another: for if the atoms did not find the body ſo denſe as it is, they could not by their beating upon one part make another be divided.

So that a denſe body to be more heavy than denſe, ſignifieth nothing elſe, but that it is in ſuch a degree of denſity, that ſome of its own parts by their being aſſiſted and ſet on work by a general cauſe (which is the fall of the atoms) are powerfull enough to divide other adjoining parts of the ſame denſity with them one from another; in ſuch ſort as we ſee that water powred out of an ewer into a baſin where there is already other water, hath the power to divide the water in the baſin by the aſſiſtance

stance of the celerity which it getteth in descending. And now I hope the reader is fully satisfied that there is no contradiction in putting *Density* and *Gravity* to be the same thing materially, and that nevertheless the same thing may be more heavie than dense, or more dense than heavy, as we took it to our several purposes in the investigation of Elements.

II. The opinion of gravities being an intrinsecal inclination of a body to the center, refuted by reason.

Having thus laid an intelligible ground to discover how these motions that are general to all bodies and are natural in chief, are contrived by nature; we will now endeavour to shew that the contrary position is not onely voluntary, but also impossible. Let us therefore suppose that a body hath a quality to move it downwards. And first we shall ask what downwards signifieth: for either it signifieth towards a fixed point of imaginary space; or towards a fixed point of the universe; or towards some movable point. As for the first, who would maintain it must have more imagination than judgment, to think that a natural quality could have an essence determined by a nothing: because we can frame a conceit of that nothing. As for the second, it is very uncertain whether any such point be in a nature: for as for the center of the earth, it is clear that if the earth be carried about, the center of it cannot be a fixed point. Again, if the center signifieth a determinate point in the earth that is the medium of gravity or of quantity, it is changed as often as any dust lighteth unequally upon any one side of the earth, which would make that side bigger than it was: and I doubt a quality cannot have moral considerations to think that so little doth no harm. As for the third position, likewise it is not intelligible how a quality should change its inclination or essence, according to the change that should light, to make now one point, now another, be the center unto which it should tend.

Again, let us consider that a quality hath a determinate essence. Then seeing its power is to move, and to move signifieth to cut the medium it is moved in; it belongeth unto it of its nature to cut so much of such a medium in such a time. So that if no other cause be added but that you take precisely and *in abstracto*, that quality, that medium, & that time; this effect will follow, that so much motion is made. And if this effect should not follow, it is clear that the being able to cut so much of such a medium in such a time, is not the essence of this quality, as it was supposed to be. Dividing then the time and the medium, half the motion should be

be made in half the time, a quarter of the motion in a quarter of the time, and so without end, as far as you can divide. But this is demonstratively impossible, sith hence it is demonstrated, that a moveable coming from rest, must of necessity pass through all degrees of tardity; and therefore by the demonstration cited out of *Galileus*, we may take a part in which this gravity cannot move its body in a proportionate part of time, through a proportionate part of the medium.

91. The same opinion refuted by several experiences.

But because in natural Theorems, experiences are naturally required; let us see whether nature giveth us any testimony of this verity. To that purpose we may consider a plummet hanged in a small string from a beam, which being lifted up gently on the one side at the extent of the string, and permitted to fall merely by the power of gravity, it will ascend very near as high on the contrary side, as the place it was held in from whence it fell. In this experiment we may note two things: the first, that if gravity be a quality, it worketh against its own nature in lifting up the plummet, seeing its nature is onely to cary it down. For though it may be answered, that it is not the gravity but another quality called *vis impressa* which carrieth it up: nevertheless it cannot be denied, but that gravity is either the immediate or at least the mediate cause which maketh this *vis impressa:* the effect whereof being contrary to the nature of gravity, it is absurd to make gravity the cause of it: that is, the cause of an effence, whose nature is contrary to its own. And the same argument will proceed though you put not *vis impressa*, but suppose some other thing to be the cause of the plummets remounting, as long as gravity is said to be a quality: for still gravity must be the cause of an effect contrary to its own inclination, by setting on foot the immediate cause to produce it.

The second thing we are to note in this experiment of the plummets ascent is, that if gravity be a quality, there must be as much resistance to its going up, as there was force to its coming down. Therefore there must be twice as much force to make it ascend, as there was to make it descend: that is to say, there must be twice as much force as the natural force of the gravity is: for there must be once as much to equalize the resistance of the gravity; and then another time as much, to carry it

it as far through the same medium in the same time. But it is impossible that any cause should produce an effect greater than it self.

Again, the gravity must needs be in a determinate degree: and the vertue that maketh the plummet remount (whatsoever it be) may be put as little as we please: and consequently not able to oversway the gravity alone if it be an intrinsecal quality, and yet the plummet will remount: in which case you put an effect without a cause.

Another experience we may take from the force of sucking; for take the barrel of a long gun perfectly bored, and set it upright, with the breech upon the ground, and take a bullet that is exactly fit for it, but so as it stick not any where (both the barrel and it being perfectly polished;) and then if you suck at the mouth of the barrel (though never so gently) the bullet will come up so forcibly, that it will hazard the striking out of your teeth. Now let us consider what force were necessary to suck the bullet up, and how very slowly it would ascend, if in the barrel it had as much resistance to ascend, as in the free air it hath inclination to go down. But if it had a quality of gravity natural to it, it must of necessity have such resistance: whereas in our experiment we see it cometh as easily as the very air. So that in this example, as well as in the other, nature teacheth us that gravity is no quality.

And all or most of the arguments which we have urged against the quality of gravity in that explication we have considered it in, have force likewise against it, although it be said to be an inclination of its subject to move it self unto unity with the main stock of its own nature, as divers witty men do put it: for this supposition doth but change the intention or end of gravity: and is but to make it another kind of intellectual or knowing Entity, that determineth it self to another end: which it as impossible for a natural quality to do, as to determine it self to the former ends. And thus much the arguments we have proposed do convince evidently, if they be applyed against this opinion.

CHAP.

CHAP. XII.

Of Violent Motion.

1. The state of the question touching the cause of violent motion.

AND thus we have given a short scantling, whereby to understand in some measure the causes of that motion which we call natural, by reason it hath its birth from the universal occonomy of nature here among us; that is, from the general working of the sun, whereby all natural things have their course: and by reason that the cause of it is at all times and in all places constantly the same. Next unto which the order of discourse leadeth us to take a survey of those forced motions, whose first causes the more apparent they are, the more obscurity they leave us in to determine by what means they are continued.

When a tennis-ball is strucken by a racket, or an arrow is shot from a bow, we plainly see the causes of their motion: namely the strings, which first yielding, and then returning with a great celerity, do cause the missives to speed so fast towards their appointed homes. Experience informeth us what qualities the missives must be endued withall to move fast and steadily. They must be so heavy that the air may not break their course; and yet so light, that they may be within the command of the stroke which giveth them motion; the striker must be dense, and in its best velocity: the angle which the missive is to mount by (if we will have it go to its furthest randome) must be the half of a right one: and lastly, the figure of the missive must be such, as may give scope unto the air to bear it up, and yet not hinder its course by taking too much hold of it. All this we see; but when withall we see that the mover deserteth the moveable assoon as he hath given the blow; we are at a stand, and know not where to seek for that which afterwards maketh it flie: for motion being a transient, not a permanent thing, assoon as the cause ceaseth that begot it, in that very point it must be at an end; and as long as the motion continueth, there must be some permanent cause to make it do so: so that as soon as the racket or bowstring go back and leave the ball or arrow, why should not they presently fall straight down to the ground?

2. That the medium is the onely

Aristotle and his followers have attributed the cause hereof to the air: but *Galileo* relisheth not this conception. His argu-

ments

ments against it, are (as I remember) to this tenour: first, air by reason of its rarity and divisibility, seemeth not apt to conserve motion: next, we see that light things are best carried by the air; and it hath no power over weighty ones: lastly, it is evident that air taketh most hold of the broadest superficies; and therefore an arrow would flie faster broad-waies than longwaies, if this were true. Nevertheless, since every effect must have a proportionable cause from whence it immediately floweth; and that a body must have another body to thrust it on as long as it moveth; let us examine what bodies do touch a moveable whilest it is in motion, as the onely means to find an issue out of this difficulty; for to have recourse unto a quality or impressed force for deliverance out of this streight, is a shift that will not serve the turn in this way of discourse we use. In this Philosophy no knot admitteth such a solution. cause, which continueth violent motion.

If then we inquire what body it is that immediately toucheth the ball or arrow whiles it flieth; we shall find that none other doth so but the air and the atoms in it, after the strings have given their stroke, and are parted from the missive. And although we have *Galileos* authority, and arguments to discourage us from believing that the air can work this effect; yet since there is no other body besides it left for us to consider in this case, let us at the least examine how the air behaveth it self after the stroke is given by the strings. First then it is evident that assoon as the racket or bowstring shrinketh back from the missive, and leaveth a space between the missive and it (as it is clear it doth, assoon as it hath strucken the resisting body) the air must needs clap in with as much velocity as they retire, and with somewhat more; because the missive goeth forward at the same time, and therefore the air must hasten to overtake it, lest any vacuity should be left between the string and the arrow. It is certain likewise, that the air on the sides doth also upon the division of it, slide back and help to fill that space which the departed arrow leaveth void. Now this forcible closing of the air at the nock of the arrow, must needs give an impurse or blow upon it: if it seem to be but a little one, you may consider how it is yet much greater, than what the air and the bodies swimming in it, do at the first give unto a stone falling from high; and how at the last those little atoms that drive a

stone.

ſtone in its natural motion, do with their little blows force it peradventure more violently & ſwiftly than any impelling agent we are acquainted with can do. So that the impulſe which they make upon the arrow, preſſing violently upon it after ſuch a vehement concuſſion, and with a great velocity, muſt needs cauſe a powerfull effect in that which of it ſelf is indifferent to any motion any way.

3. A farther explication of the former doctrine.

But unleſs this motion of the air do continue to beat ſtill upon the arrow, it will ſoon fall to the ground, for want of a cauſe to drive it forward; and becauſe the natural motion of the air (being then the onely one) will determine it downwards. Let us conſider then how this violent rending of the air by the blow that the bow-wring giveth unto the arrow, muſt needs diſorder the little atoms that ſwim to and fro in it, and that (being heavier than the air) are continually deſcending downwards. This diſorder maketh ſome of the heavier parts of them, get above others that are lighter than they; which they not abiding, do preſs upon thoſe that are next them, and they upon their fellows: ſo that there is a great commotion and undulation cauſed in the whole maſs of air round about the arrow: which muſt continue ſome time before it can be ſettled: and it being determined by the motion of the arrow that way that it flideth, it followeth, that all this commotion and undulation of the air, ſerveth to continue the arrow in its flight. And thus faſter than any part behind can be ſettled, new ones before are ſtirred, till the reſiſtance of the medium do grow ſtronger than the impulſe of the movers.

Beſides this, the arrow preſſing upon the air before it, with a greater velocity than the air (which is a liquid rare body) can admit, to move all of a piece without breaking: it muſt of neceſſity happen that the parts of the air immediately before the arrow be driven upon others farther off, before theſe can be moved to give place unto them; ſo that in ſome places the air becometh condenſed, and conſequently in others rarified. Which alſo the wind that we make in walking (which will ſhake a paper pinned looſly at the wall of a chamber towards which we walk) and the cooling air cauſed by fanning when we are hot do evidently confirm. So that it cannot be doubted, but that condenſation and rarefaction of the air muſt neceſſarily follow the

the motion of any solid body: which being admited, it is evident that a great disorder, and for some remarkable time, must necessarily be in the air; since it cannot brook to continue in more rarity or denfity than is natural unto it. Nor can weighty and light parts agree to rest in an equal height or lowness; which the violence of the arrows motion forceth them unto for the present. Therefore it cannot be denied, but that though the arrow slide away, nevertheless there still remaineth behind it (by this condensation and confusion of parts in the air) motion enough to give impulse unto the arrow, so as to make it continue its motion after the bow-string hath left it.

But here will arise a difficulty: which is, how this clapping in and undulation of the air should have strength and efficacy enough to cause the continuance of so smart a motion, as is in arrows shot from a bow. To this I need no other argument for an answer than to produce *Galileos* testimony, how great a body one single mans breath alone can in due circumstances give a rapid motion unto: and withall, let us consider how the arrow and the air about it are already in a certain degree of velocity; that is to say, the obstacle that would hinder it from moving that way (namely, the resistance of the air) is taken away; and the causes that are to produce it (namely the determining of the aires, and of the atoms motion that way) are hightened; And then we may safely conclude, that the arrow which of it self is indifferent to be moved upwards or downwards, or forwards, must needs obey that motion which is caused in it by the atoms, and the airs pressing upon it; either according to the impulse of the string, or (when the string begimneth to flag) according to the beatings that follow the general constitution of nature; or in a mixt manner according to the proportions that these two hold to one another. Which proportions *Galileus* in his 4. Dialogue of motion hath attempted to explicate very ingeniously: but having missed in one of his suppositions; to wit, that forced motion upon an horizontal line, is throughout uniform; his great labours therein have taken little effect towards the advancing the knowledge of nature, as he pretended: for his conclusions succeed not in experience, as *Mersenius* assureth us after very exact trials; nor can they in their reasons be fitted to nature.

4. That the air hath strength enough to continue violent motion in a moveable. Dial. 1. of motion, pag. 98.

So that to conclude this point, I find no difficulty in allowing this

this motion of the air ſtrength enough to force the moveable onwards, for ſome time after the firſt mover is ſevered from it; (and long after, we ſee no motions of this nature do endure:) ſo that we need ſeek no further cauſe for the continuance of it: but may reſt ſatisfied upon the whole matter, that ſince the cauſes and circumſtances our reaſon ſuggeſteth unto us, are after mature and particular examination proportionable to the effects we ſee, the doctrine we deliver muſt be ſound and true.

5. An anſwer to the firſt objection; that air is not apt to conſerve motion. And how violent motion cometh to ceaſe:

For the eſtabliſhing whereof, we need not (conſidering what we have already ſaid) ſpend much time in ſolving *Galileos* arguments againſt it: ſeeing that, out of what we have ſet down, the anſwers to them appear plain enough; for firſt we have aſſigned cauſes how the air may continue its motion long enough to give as much impreſſion as is needfull unto the arrow, to make it go on as it doth. Which motion is not requiſite to be near ſo great in the air behind the arrow (that driveth it on) as what the arrow cauſeth in the air before it: for by reaſon of the denſity of it, it muſt needs make a greater impreſſion in the air it cutteth, than the air that cauſeth its motion, would do of it ſelf without the mediation of the arrow. As, when the force of a hand giveth motion unto a knife to cut a loaf of bread, the knife, by reaſon of the denſity and of the figure it hath, maketh a greater impreſſion in the loaf, than the hand alone would do. And this is the ſame that we declared in the natural motion of a heavie thing downwards, unto which we aſſigned two cauſes; namely, the beating of the atomes in the air, falling down in their natural courſe, to determine it the way it is to go; and the denſity of the body, that cutting more powerfully than thoſe atoms can do, giveth (together with their help) a greater velocity unto the moveable, than the atoms of themſelves can give.

Nor doth it import that our reſolution is againſt the general nature of rare and denſe bodies, in regard of conſerving motion; as *Galileo* objecteth: for the reaſon why denſe bodies do conſerve motion longer than rare bodies, is becauſe in regard of their dividing virtue, they get in equal times a greater velocity. Wherefore ſeeing that velocity is equal unto gravity; it followeth, that reſiſtance worketh not ſo much upon them as upon rare bodies; and therefore cannot make them ceaſe from mo-

tion

tion so easily as it doth rare bodies. This is the general reason for the conservation of motion in dense bodies. But because in our case, there is a continual cause which conserveth motion in the air, the air may continue its motion longer than of it self it would do: not in the same part of air which *Galileus* (as it seemeth) did aim at: but in divers parts, in which the movable successively is.

Which being concluded, let us see how the forced motion cometh to decrease and to be ended. To which purpose we may observe that the impression which the arrow receiveth from the air that driveth it forwards, being weaker than that which it received at the first from the string, (by reason, that the air is not so dense, and therefore cannot strike so great a blow) the arrow doth not in this second measure of time, (wherein we consider the impulse given by the air only) cut so strongly the air before it, nor press so violently upon it, as in the first measure: when the string parting from it did beat it forwards: for till than the velocity encreaseth in the arrow, as it doth in the string that carrieth it along, which proceedeth from rest at the fingers loose from it, to its highest degree of velocity; which is, when it arriveth to the utmost extent of its jerk, where it quitteth the arrow. And therefore, the air now doth not so swiftly, nor so much of it, rebound back from before, and clap it self behind the arrow, to fill the space that else would be left void by the arrows moving forward, and consequently the blow it giveth in the third measure, to drive the arrow on, cannot be so great as the blow was immediately after the strings parting from it; which was in the second measure of time: and therefore the arrow must needs move slower in third measure than it did in the second; as formerly it moved slower in the second (which was the airs first stroke) then it did in the first, when the string drove it forwards. And thus successively in every moment of time, as the causes grow weaker and weaker by the increase of resistance in the air before, and by the decrease of force in the subsequent airs; so the motion must be slower and slower, till it come to pure cessation.

6. An answer to the second objection that the air hath no power over heavy bodies.

As for *Galileus* second argument; that the air hath little power over heavy things; and therefore he will allow it to be the cause of continuing forced motions in dense bodies: I wish he could as well have made experience what velocity of motion

a mans breath might produce in an heavy bullet lying upon an even, hard, and slipery plain, (for a table would be too short) as he did, how admirable great a one it produced in pendants hanging in the air: and, I doubt not but he would have granted it as powerfull in causing horizontal motions, as he found it in the undulations of his pendants. Which nevertheless, do sufficiently convince how great a power air hath over heavy bodies. As likewise the experience of wind-guns assureth us that air duly applied is able to give greater motion unto heavy bodies than unto light ones. For how can a straw or feather be imagined possibly to fly with half the violence as a bullet of lead doth out of one of those engines? And when a man sucketh a bullet upwards in a perfectly bored barrel of a gun, which the bullet fitteth exactly (as we have mentioned before) with what a violence doth it follow the breath and ascend to the mouth of the barrel? I remember to have seen a man that was uncautious and sucked strongly that had his foreteeth beaten out by the blow of the bullet ascending.

This experiment (if well looked into may peradventure make good a great part of this doctrine we now deliver. For, the air pressing in behind the bullet at the touch-hole, giveth it its impulse upwards; unto which the density of the bullet being added, you have the cause of its swiftness and violence; (for a bullet of wood or cork, would not ascend so fast and so strongly) and the sucking away of the air before it, taketh away that resistance which otherwise it would encounter with by the air lying in the way of it: and its following the breath with so great ease, sheweth (as we touched before) that of it self it is indifferent to any motion, when nothing presseth upon it to determine it a certain way.

7. An answer to the third objection, that an arrow should fly faster broad-waies, than long-waies.

Now to *Galileos* last argument, that an arrow should fly faster broad-waies, than long-waies, if the air were cause of its motion: there needeth no more to be said, but that the resistance of the air before hindreth it as much as the impulse of the air behind helpeth it on; so that nothing is gained in that regard; but much is lost, in respect of the figure; which maketh the arrow unapt to cut the air so well when it flieth broad-waies, as when it is shot long-waies: and therefore the air being weakly cut, so much of it cannot clap in behind the arrow and drive it on, against the resistance before which is much greater.

Thus far with due respect, and with acknowledging remem-

brance of the many admirable mysteries of nature which that great man hath taught the world, we have taken liberty to dispute against him: because this difficulty seemeth to have driven him against his Genius, to believe that in such motions there must be allowed a quality imprinted into the moved body to cause them: wch our whole scope both in this, and in all other occasions where like qualities are urged, is to prove them superfluous and ill grounded in nature; and to be but meer terms to confound & leave in the dark whosoever is forced to fly unto them.

CHAP. XIII.

Of three sorts of violent motion, Reflection, Undulation, and Refraction.

THe motion we have last spoken of, because it is ordinarily either in part or wholly contrary to gravity (which is accounted the natural motion of most bodies) useth to be called violent or forced. And thus you have delivered unto you the natures and causes both of natural and of forced motion; yet it remaineth that we advertise you of some particular kindes of this forced motion, which seem to be different from it, but indeed are not. As first, the motion of reflection; which if we do but consider how forced motion is made; we shall find that it is nothing else but a forced motion, whose line whereupon it is made, is as it were snapped in two by the encounter of a hard body. For even as we see in a spout of water that is strongly shot gainst a wall, the water following driveth the precedent parts first to the wall, and afterwards coming themselves to the wall, forceth them again another way from the wall: right so, the latter parts of the torrent of air, which is caused by the force that occasioned the forced motion, driveth the former parts, first upon the resistant body, and afterwards again from it. But this is more eminent in light than in any other body, because light doth less rissent gravity; and so observeth the pure course of the stroke, better than any other body; from which others do for the most part decline some way by reason of their weight.

1. That reflexion is a kind of violent motion.

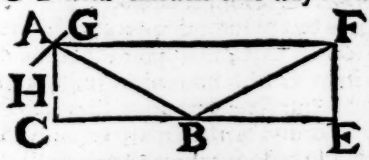
Now the particular law of reflexion is, that the line incident, & the line of reflexion must make equal angles with that line of the resistant superficies wch is in the same superficies with themselves. The demonstration whereof, that great wit *Renatus Des Cartes* hath

2. Reflexion is made at equa angles.

hath excellently set down in his book of Dioptrikes by the example of a ball strucken by a racket against the earth, or any resisting body: the substance whereof is as followeth.



In the Rectangle Parallelogramme A E, let C E be the superficies of the Earth: A, the point from which the racket H G, striketh the Ball by the line A B, to the point B in the superficies of the earth: and let us consider C, to be on the left hand, and E on the right. Now we are to shew that the Ball will rebound by the line B F, to the point F, in the same time in which it went from A to B; and to make the angle A B C equal to the angle F B E. For the effecting whereof, we must abstract, according to the manner of Mathematicians, from all Physical inequalities, and suppose the superficies C E, to be Mathematically plain, and the force of the racket to continue equally strong in B as it is in A, for although in truth, neither of these be rigorously so; nevertheless, because there is no sensible defect in any operation that dependeth on them, it is the same to our purpose as if they were Mathematically so. We see then that the racket H G, doth in a certain time drive the ball from A to B; that is to say, from the left hand to the right, as far as from C to B; and from above to downwards as far as from A to C. We see again, that the superficies C E, is not contrary unto this motion of the ball, as it goeth from the left had to the right; for the line C E lieth likewise that way: but is contrary unto it, as it



goeth from above downwards; for in that course the superficies C E encountereth and putteth a period to the line A C. And therefore the motion of the ball when it meeteth with the superficies C E, must be changed from the line A C, so much as the superficies C E is contrary unto it; that is quite backwards as far as it dependeth of that opposition. Therefore, when the ball is come to B, it must go from thence in the same proportion of left hand to right hand, and from below upwards, as it came before from left hand to right

hand, and from above downwards, when it came from A to B. And consequently, it must in equal time have passed another line from left hand to right hand, as long as the line C B; and likewise, it must at the same time have passed another line from below upwards, as long as A C: which will of necessity make it hit in the point F, at the end of so much more time as it spent in going from A to B; and so, make the two angles A B C and F B E equal; as every one knoweth that hath but saluted *Euclide*.

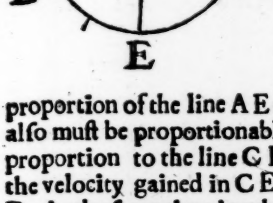
3. The causes and properties of undulation.

The motion which we call undulation needeth no farther explication: for it is manifest, that since a pendant, when it is removed from its perpendicular, will restore it self thereunto by the natural force of gravity, and that in so doing it gaineth a velocity, (and therefore cannot cease on a suddain,) it must needs be carried, out of the force of that motion, directly the contrary way: until the force of gravity overcoming the velocity, it must be brought back again to the perpendicular: which being done likewise with velocity, it must send it again towards the place from which it fell at the first. And in this course of motion it must continue for a while, every undulation being weaker than other, until at last it quite ceaseth, by the course of nature settling the air in its due situation according to the natural causes that work upon it. And in this very manner also is performed that undulation which we see in water, when it is stirred from the natural situation of its spherical superficies.

Galileo hath noted that the time in which the undulations are made which follow one another of their own accord, is the same in every one of them; and that as much time precisely is taken up in a pendants going a very short arch towards the end of its vibration, as was in its going of the greatest arch at the beginning of its motion. The reason whereof seemeth strange to him, and he thinketh it to be an accident natural to the body out of its gravity; and that this effect convinceth, it is not the air which moveth such bodies. Whereas in truth, it is clearly the air which causeth this effect. Because the air striving at each end (where it is furthest from the force of the motion) to quiet it self, getteth at every bout somwhat upon the space; and so contracteth that into a shorter arch.

But it is a great wonder to me, that *Galileo* should make a

wonder of this effect to the reason which he hath laid so fair a foundation upon another occasion, had he but reflected upon it. For in his fourth dialogue of motion he hath demonstrated that a natural movable descending in the quarter of a circle, from what part soever it beginneth, spendeth equal time to come to the lowest point, as if it came from any other part: so that a pendant being brought up to any height by the force of a former motion downwards, it will be sure to spend as much time in going down from thence to the perpendicular, as it did at the first when it was let fall from the greatest height. Now I subsume, that the pendants ascending, being the effect of the velocity of its motion gained in descending immediately before; the said velocity must be able to carry it in the same time to a height, that is proportionate to that height unto which the velocity gained in the first fall did cause the pendant to mount. As for example, if the pendants first descent were from A to E, the second from C to E; because the time of those two is the same, (as *Galileus* hath demonstrated) it followeth that their velocities gained in descending must of necessity be in the proportion of the line A E to the line C E: therefore, their effects also must be proportionable. Let us then put the line E D in that proportion to the line C E, which C E hath to A E, and then the velocity gained in C E will carry the pendant up from E to D, in the same time in which the descent A E did carry it up the other way from E to C: wherefore, seeing that the times of its descent from A to E, and from C to E are equal; likewise, the two vibrations from A to C and from C to D will be done in equal times. But that which made *Galileo* not see the force of the consequence, was that he did not acknowledge violent motion to be made in the same proportions, and for the same reasons which are found in natural motion: which we have above shewed to be so, where we discoursed of that matter.



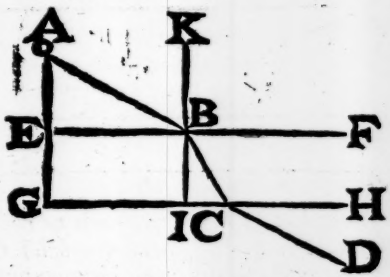
4. Refraction at the entrance into the reflectent body is

That motion also which we call *Refraction*, and is manifest to sense, onely in light; (though peradventure hereafter more diligent searchers of nature, may likewise finde it in such other bodies as are called qualities; as in cold or heat, &c.) is but a kind

kind of Reflexion: for there being certain bodies, in which the passages are so well ordered with their resistances, that all the parts of them seem to permit light to passe through them, and yet all parts of them seem to reflect it; when light passeth through such bodies, it findeth at the very entrance of them, such resistances where it passeth, as serve it for a reflectent body; and yet such a reflectent body, as hindereth not the passage through; but onely hindereth the passage from being in a straight line with the line incident. Wherefore the light must needs take a ply as beaten from those parts towards a line drawn from the illuminant, falling perpendicularly upon the resisting superficies; and therefore is termed by Mathematicians, to be refracted or broken towards the perpendicular. Now at the very going out again of the light, the second superficies (if it be parallel to the former) must needs upon a contrary cause, strike it the contrary way: which is termed from the perpendicular.

towards the perpendicular; at the going out it is from it; when the second superficies is parallel to the first.

As for example: if the ray A B, lighteth upon the superficies E B F, and findeth entrance; it is not now the superficies E F, that resisteth or reflecteth it: but it is that part of the inside (as we may say) of the pore B, which is towards F; and is a Physical body, not a Mathematical point. The reflexion therefore must be made, as if the reflectent body were I B K: but it is evident that if A B, did strike upon I K, it would reflect towards A G. But because we know not the inclination of the superficies I K, whether it be truly a perpendicular or no, therefore we cannot tell the quantity of the inclination which this reflexion must make; but onely we know that it must be towards A G.

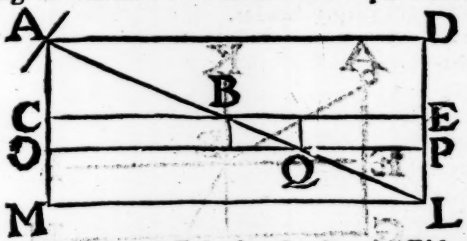


5. A refutation of *Monsieur Des Cartes* his explication of refraction.

But before we wade any deeper into this difficulty, we cannot omit a word of the manner of explicating refraction which *Monsieur Des Cartes* useth, so witty a one a I am sorry it wanteth success. He therefore following the demonstration above

given of reflexion; supposeth the superficies which a ball lighteth upon, to be a thin linen cloth, or some other such matter as will break cleanly by the force of the ball striking smartly upon it. And because that superficies resisteth onely one way, therefore he inferreth that the velocity of the ball is lessened only one way and not the other: so that the velocity of its motion that way in which it findeth no resistance, must be (after the balls passage through the linen) in a greater proportion to the velocity which it hath the other way where it findeth resistance, than it was before. And therefore the ball will in less time arrive to its period on the one side than on the other: and consequently, it will lean towards that side, unto which the course wherein it findeth no opposition doth carry it.

But how much he is mistaken upon the whole matter a little figure will shew: let us therefore put a Rectangle Parallelogram as before A E, which I double & make the whole Parallelogram A L, and draw out the line A B, till it cometh to L. Now we must imagine that C E is the cloath or passable superficies which *Monsieur Des Cartes* putteth; and B L the line it would go in, if there were no resistance. Next we must seek the perpendicular, which according to our explication, is A C: for that falleth from A the illuminant, perpendicularly upon C E; although, some who defend *Monsieur Des Cartes*, seem to make another line the perpendicular; against the conception of all those that write of Opticks. But, not to trouble our selves with terms; the question is, whether the ball that passeth the cloth, must (after its passage through) deflect from the line B L, (which it would have kept, had there been no resistance) towards E; or else deflect from that line towards C. And both experience and reason do assure us, that it must turn towards C: but *Monsieur Des Cartes* saith towards E.



Which to shew how it is contrary unto his own principle; let us,

us conceive the cloth C E to be of some thickness, and so draw the line O P to determine that thickness, And let us make from B upon A L, another Parallelogram like the Parallelogram A L, whose diameter shall be B Q. And it must necessarily follow that the motion from B to Q, if there were no resistance, were in the same proportion as from A to B. But the proportion of the motion from A to B, is the proportion of C B to C A; that is, it goeth in the same time faster towards D, than it doth towards M, in the proportion which C B hath to C A. By which account, the resistance it hath in the way towards D, must also be greater than the resistance it hath in the way towards M, in the proportion which C B hath to C A; and therefore the more tardity must be in the way to D, and not in the way to M; and consequently, the declination must be from E wards, and to M wards. For where there is most resistance, that way likewise must the tardity be greatest, & the declination must be from that way: but which way the thickness, to be passed in the same time, is most, that way the resistance is greatest: and the thickness is clearly greater towards E, than towards M; therefore, the resistance must be greatest towards E; & consequently the declination from the line B L must be towards M, and not towards E.

But the truth is, that in his doctrine the ball would go in a straight line as if there were no resistance; unless peradventure towards the contrary side of the cloth, at which it goeth out into the free air: for as the resistance of the cloth is greater in the way towards D, than in the way towards M, (because it passeth a longer line in the same time, as also it did formerly in the air) so likewise is the force that moveth it that way greater than the force which moveth it the other. And therefore the same proportions that were in the motion, before it came to the resisting passage, will remain also in it: at the least until coming neer the side at which it goeth out, the resistance be weakned by the thinness of the resistent there: which because it must needs happen on the side that hath least thickness, the ball must consequently turn the other way, where it findeth greatest yielding: and so at its getting out into the free air, it will bend from the greater resistance, in such manner as we have said above.

Neither do the examples brought by *Monsieur Des Cartes* and others in maintenance of this doctrine any thing avail them:

An answer to the arguments brought in favour of *Monsieur Des Cartes* his opinion.

them: for when a canon bullet shot into a river, hurteth the people on the other side; it is not caused by refraction, but by reflexion, as *Monsieur Des Cartes* himself acknowledgeth: and therefore, hath no force to prove any thing in refraction; whose laws are divers from those of pure reflexion.

And the same answer serveth against the instance of a musket bullet shot at a mark under water; which perpetually lighteth higher than the mark, though it be exactly just aimed at. For we knowing that it is the nature of water, by sinking in one place to rise round about, it must of necessity follow that the bullet which in entring hath pressed down the first parts of the water, hath withall thereby put others farther off in a motion of rising: and therefore the bullet in its going on must meet with some water swelling upwards: and must from it receive a ply that way, which cannot fail of carrying it above the mark it was levelled at. And so we see this effect proceedeth from reflexion or the bounding of the water, and not from refraction. Besides that, it may justly be suspected the shooter took his aim too high, by reason of the marks appearing in the water higher than in truth it is: unless such false aiming were duly prevented.

Neither is *Monsieur Des Cartes* his excuse to be admitted, when he saith that light goeth otherwise than a ball would do, because that in a glass or in water, the etherial substance which he supposeth to run through all bodies, is more efficaciously moved than in air: and that therefore light must go faster in the glass than in the air, and so turn on that side of the straight line which is contrary to the side that the ball taketh, because the ball goeth not so swiftly. For (not to dispute of the verity of this proposition) the effect he pretendeth is impossible: for if the etherial substance in the air before the glass be slowly moved, (the motion of which he calleth light) it is impossible that the etherial substance in the glass or in the water should be more smartly moved than it. Well it may be less; but without all doubt the impulse of the etherial substance in the glass cannot be greater than its adequate cause, which is the motion of the other parts that are in the air precedent to glass.

Again, after it is passed the glass, it should return to be a straight line with the line that it made in the air precedent to the glass: seeing that the subsequent air must take off just as much (and no more) as the glass did add: the contrary whereof experience sheweth us.

Thirdly

Thirdly, in this explication it would alwaies go one way in the air, and another way in the glass: whereas all experience testifieth, that in a glass convex on both sides, it still goeth in the air after its going out to the same side as it did in the glass; but more. And the like happeneth in glasses on both sides concave. Wherefore it is evident, that it is the superficies of the glass that is the worker on both sides; and not the substance of the air on the one side, and of the glass on the other.

And lastly, his answer doth no way solve our objection, which proveth that the resistance both waies is proportionate to the force that moveth, and by consequence that the thing moved must go straight. As we may imagine would happen if a bullet were shot sloping through a green mud wall, in which there were many round sticks so thin set that the bullet might passe with ease through them; for as long as the bullet touched none of them (which expresseth his case) it would go straight; but if it touched any of them (which resembleth ours, as by and by will appear) it would glance according to the quality of the touch, and move from the stick in another line.

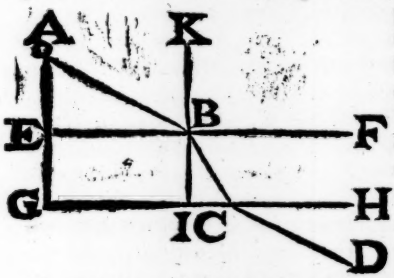
Some peradventure may answer for *Monsieur Des Cartes* that this subtile body which he supposeth to run through all things is stiff and no waies pliable. But that is so repugnant to the nature of rarity, and so many insuperable inconveniencies do follow out of it; as I cannot imagine he will own it; and therefore I will not spend any time in replying thereunto.

We must therefore seek some other cause of the refraction of light, which is made at the entrance of it into a diaphanous body. Which is plainly (as we said before) because the ray striking against the inside of a body it cannot penetrate, turneth by reflexion towards that side on which the illuminant standeth: and if it findeth clear passage through the whole resistant, it followeth the course it first taketh; if not, then it is lost by many reflexions to and fro.

7. The true cause of refraction of light both at its entrance, and at its going out from the reflecting body.

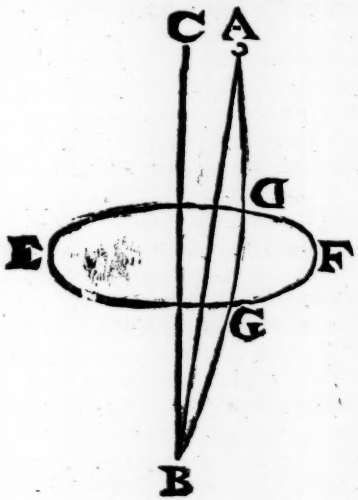
And that this doctrine is true, the accidents or Phenomenas evidently declare unto us; for experience teacheth us, that upon a plain superficies the refraction is made towards the perpendicular drawn from the illuminant to the superficies; as we have said. Now at the going out (if the surfaces be parallels) we see that the ray turneth from that perpendicular; which also is necessary:

ceſſary; for going through a pore bigger than it ſelf, or at the leaſt as big; and finding it full of air, it muſt needs be crowded there. But in a crowd, he preſſeth you moſt whom you preſs moſt upon: ſo then that ſide of the pore which is next to the light as it



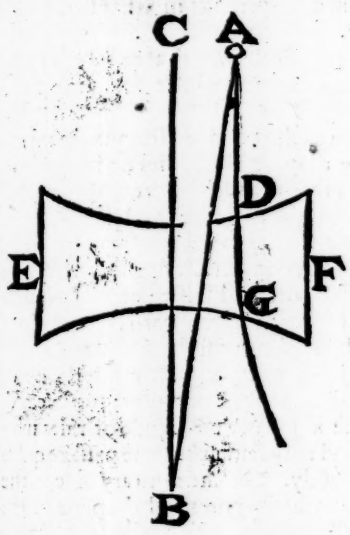
paſſeth, muſt preſs moſt upon it: but the angle wch is towards the perpendicular, to wit, the angle B C I, is the leſſer; and by conſequence, the ray is neerer that ſide of the pore which is towards I, than the other ſide of it wch is towards H; wherefore it muſt take its ply from that ſide. But that ſide ſtriketh it from the perpendicular: and therefore it muſt there refract from the perpendicular.

This very ſame doctrine for the reaſon of refraction is confirmed by what happeneth in crooked ſuperficieſes. As if E F be a *Lens* or a glaſs on both ſides convex; and C B the axis of it; A D the ray falling from the illuminant A; A B the perpendicular falling from the ſame illuminant A: it will be plain by the former diſcourſe, that the ray A D, muſt at the entry be refracted towards A B, as being repulſed from that part of the inſide of the pore D, which is towards F; becauſe that ſide is moſt oppoſed unto the ray. Now the ray being once turned that way; when at the end of its journey through the



glaſs

glass, it is come to the other superficies E G F, it maketh the lesser angle towards F; and therefore must it by the rule given above be refracted again at its parting from the glass, towards the same perpendicular; and it will meet somewhere with the axis C B; all which experience sheweth us to be true.



And taking a body of concave surfaces we shall (according to this doctrine of ours) finde the causes of refraction just contrary; and accordingly experience likewise sheweth us the effects to be so too. And therefore since experience agreeth exactly with our rules, we cannot doubt but that the principles upon which we go are well laid.

8. A general rule to know the nature of reflexions and refractions in all sorts of surfaces.

But because crooked surfaces may have many irregularities; it will not be amisse to give a rule by which all of them may be brought unto a certainty. And this it is, that reflexions from crooked superficieses are equal to the reflexions that are made from such plain superficieses, as are tangents to the crooked ones in that point from whence the reflexions are made. Which principle the Masters of the Opticks do take out of a Mathematical supposition of the unity of the reflecting point, in both the surfaces; the crooked and the plain: but we take it out of the insensibility of the difference of so little a part in the two different surfaces, as serveth to reflect a ray of light: for where the difference is insensible in the causes, there likewise the difference is so little in the effects, as sense cannot judge of them: which is as much as is requisite to our purpose. Now seeing that in the Mathematical supposition, the point where the reflection is made, is indifferent

different to both the ſurfaces: it followeth, that it importeth not whether ſuperficies you take to know the quality of reflexion by. This principle then being ſettled, that the reflexion muſt follow the nature of the tangent ſurfaces, and it being proved, that in plain ſurfaces it will happen in ſuch ſort as we have explicated, it followeth that in any crooked ſurperficies of what figure ſoever the ſame alſo will happen.

Now ſeeing we have formerly declared, that refractions are but a certain kinde of reflexions, what we have ſaid hereof reflexions may be applyed to refractions.

9. A body of greater parts and greater pores maketh a greater refraction than one of leſſer parts and leſſer pores.

But there remaineth yet untouched one affection more of refractions; which is that ſome diaphanous bodies do in their inwards parts reflect more than others, (which is that which we call refraction) as experience ſheweth us: concerning which effect, we are to conſider that diaphanous bodies may in their compoſition have two differences: for ſome are compoſed of greater parts and greater pores; others, of leſſer parts and leſſer pores. It is true there may be other combinations of pores and parts, yet by theſe two the reſt may be eſteemed. As for the firſt combination, we ſee that becauſe the pores are greater, a greater multitude of parts of light may paſſe together through one pore; and becauſe the parts are greater, likewiſe a greater multitude of raies may reflect from the ſame part, and may finde the ſame paſſage quite throughout the diaphanous body. On the contrary ſide in the ſecond combination where both the pores and the parts of the diaphanous body are little, the light muſt be but little that findeth the ſame paſſage.

Now that refraction is greater or leſſer happeneth two waies: for it is either when one diaphonous body reflecteth light at more angles than another, and by conſequence in a greater extent of the ſuperficies; or elſe when one body reflecteth light from the ſame point of incidence in a ſhorter line and in a greater angle than another doth. In both theſe waies it is apparent that a body compoſed of greater parts and greater pores, exceedeth bodies of the oppoſite kinde: for by reaſon that in the firſt kind more light may beat againſt one part; a body in which that happeneth, will make an appearance from a farther part of its ſuperficies: whereas in a body of the other ſort, the light that beateth againſt one of the little parts of it will be ſo little as it will

will presently vanish. Again, because in the first, the part at the incidence is greater; the surface from which the reflexion is made inwards, hath more of a plain and straight superficies: and consequently doth reflect at a greater angle, than that, whose superficies hath more of inclining.

But we must not pass from this question, without looking a little into the nature of those bodies in which refraction is made: for if they, as well as the immediate causes of refraction, do likewise favour us; it will not a little advance the certainty of our determination. To this purpose we may call to mind, how experience sheweth us that great refractions are made in smoak, and in mists, and in glasses, and in thick-bodied waters; and *Monsieur Des Cartes* addeth certain oyls, and spirits or strong waters.

10. A confirmation of the former doctrine, out of the nature of bodies that refract light.

Now most of these we see are composed of little consistent bodies, swimming in another liquid body. As is plain in smoak and mists: for the little bubbles which rise in the water before they get out of it; and that are smoak when they get into the air; do assure us that smoak is nothing else, but a company of little round bodies, swimming in the air: and the round consistence of water upon herbs, leafs, and twigs in a rind or dew, giveth us also to understand that a mist is likewise a company of little round bodies that sometimes stand, sometimes float in the air, as the wind driveth them. Our very eyes bear witness to us, that the thicker sort of waters are full of little bodies, which is the cause of their not being clear.

As for glass, the blowing of it convinceth, that the little darts of fire which pierce it every way, do naturally in the melting of it convert it into little round hollow bodies, which in their cooling must settle into parts of the like figure. Then for crystal and other transparent stones which are found in cold places; it cannot be otherwise, but that the nature of cold piercing into the main body, and contracting every little part in it self, this contraction must needs leave vacant pores between part and part. And that such transparent stones as are made by heat, have the like effect and property, may be judged out of what we see in bricks and tiles, which are left full of holes by the operation of the fire. And I have seen in bones that have lain a long time in the Sun, a multitude of sensible little pores close to one another, as if they had been formerly stuck all over with

with subtile sharp needles as close as they could be thrust in by one another. The Chymical oyls and spirits which *Monsieur Des Cartes* speaketh of, are likely to be of the same composition; since that such use to be extracted by violent fires: for a violent fire is made by the conjunction of many raies together; and that must needs cause great pores in the body it worketh upon; and the sticking nature of these spirits, is capable of conserving them.

Out of all these observations, it followeth, that the bodies in which greatest refractions do happen, are compounded (as we have said) of great parts, and great pores. And therefore, by onely taking light to be such a body as we have described it to be, where we treated of the nature of it; it is evident, that the effect which we have expreſt, must necessarily follow by way of reflexion, and that refraction is nothing else but a certain kind of reflexion.

Which last assertion, is likewise convinced out of this; that the same effects proceed from reflexion as from refraction: for by reflexion a thing may be seen greater than it is; in a different place from the true one where it is: colours may be made by reflexion, as also gloating light; and fire likewise, and peradventure all other effects which are caused by refraction, may as well as these, be performed by reflexion. And therefore it is evident, they must be of the same nature; seeing that children are the resemblances of their parents.

CHAP. XIV.

Of the composition, qualities, and generation of mixed bodies.

1. The connexion of this chapter with the rest, and the Authors intent in it.

HAving now declared the virtues by which fire and earth work upon one another, and upon the rest of the elements; which is, by light, and by the motions we have discoursed of. Our task shall be in this chapter first to observe what will result out of such action of theirs: and next, to search into the waies and manner of compassing and performing it. Which latter we shall the more easily attain unto, when we first know the end that their operation levelleth at. In this pursuit we shall find that the effect of the elements combinations, by means of the motions that happen among them; is a long pedigree of compounded qualities and bodies: wherein the first combinations (like marriages) are the breeders of the next more composed substances: and they again are the parents of others in greater variety;

variety: and so are multiplied without end; for the further this work proceedeth, the more subjects it maketh for new busines of the like kinde.

To descend in particular unto all these, is impossible. And to look farther than the general heads of them, were superfluous and troublesome in this discourse; wherein I aim onely at shewing what sorts of things in common, may be done by bodies: that if hereafter we meet with things of another nature and strain, we may be sure they are not the off-spring of bodies and of quantity; which is the main scope of what I have designed here. And to do this with confidence and certainty, requireth of necessity this leisurely and orderly proceeding that hitherto we have used, and shall continue to the end: for walking thus softly, we have alwaies one foot upon the ground; so as the other may be sure of firm footing before it settle. Whereas, they that for more haste will leap over rugged passages and broken ground, when both their feet are in the air, cannot help themselves, but must light as chance throweth them.

To this purpose then we may consider, that the qualities of bodies in common are of three sorts: for they are belonging either to the constitution of a compounded body, or else to the operation of it; and the operation of a body, is of two kinds, the one, upon other bodies, the other, upon sense. The last of these three sorts of qualities, shall be handled in a peculiar chapter by themselves. Those of the second sort, whereby they work upon other bodies, have been partly declared in the former chapters, and will be farther discoursed of in the rest of this first Treatise: so as that which remaineth for the present, is to fall upon the discourse of such qualities as concur to the constitution of bodies; with an aim to discover, whether (or no) they may be effected by the several mixtures of rarity and density, in such sort as is already declared. To which end, we are to consider in what manner these two primary differences of bodies may be joyned together; and what effects such conjunction will produce.

3. That there is a least size of bodies, and that this least size is found in fire.

As for their conjunction: to deliver the nature of it entirely, we must begin from the very root of it, and consider how the Universe being finite (which Mr. *White* hath demonstrated in the second knot of his first Dialogue) there cannot be an infinite number of bodies in it; for Geometricians shew us how the least

quantity that is, may be repeated so often as would exceed any the greatest determinate quantity whatsoever. Out of which it followeth, that although all the other bodies of the world were no bigger than the least quantity that can be designed; yet they being infinite in number, would be greater than the whole universe that containeth them. And therefore, of necessity there must be some least body, or rather, some least size of bodies: which in compounded bodies is not to be expected: for, the least parts being compounded, must needs include compounding parts less than themselves. We must then look for this least size of bodies in the Elements; which of all bodies are the simplest. And among them, we must pitch upon that, wherein is greatest divisibility, and which consequently is divided into least parts; that is, fire: so as we may conclude that among all the bodies in the world, that which of its own nature hath an aptitude to be least, must be fire.

3. The first conjunction of parts is in bodies of least size; and it is made by the force of Quantity.

Now, the least body of fire, be it never so little, is yet divisible into less. What is it then that maketh it be one? To determine this; we must resort unto the nature of *Quantity*: whose formal notion and effence is, *To be divisible*; which signifieth, that many may be made of it; but that of which many may be made, is not yet many, out of this very reason, that many may be made of it. But, what is not many, is one. Therefore what hath quantity, is, by meer having quantity, actually and formally as well one, as it hath the possibility of being made many. And consequently, the least body of fire, by having quantity, hath those parts which might be many, actually one. And this is the first conjunction of parts that is to be considered in the composition of bodies: which though is be not an actual joyning of actual parts; yet it is a formal conjunction of what may be many.

4. The second sort of conjunction is compactedness in simple Elements, and it proceedeth from density.

In the next place we may consider, how seeing the least bodies that are, be of fire; it must needs follow, that the least parts of the other Elements must be bigger than they. And consequently, the possible parts of those least parts of the other Elements must have something to conserve them together, more than is found in fire. And this, because Elements are purely distinguished by rarity and density, is straight concluded to be *density*. And thus we have found; that as quantity is the cause of the possible parts being one, so density is the cause of the like parts sticking toge-

together: which appeareth in the very definition of it, for, *to be less divisible*, (which is the notion of density) speaketh a resistance to division, or a sticking together.

Now let us examine how two parts of diff rent Elements are joyned together, to make a compound. In this conjunction we finde both the effects we have already touched: for, two such parts must make one; and moreover, they must have some resistance to divisibility. The first of these effects we have already assigned unto the nature of quantity. And it being the formal effect of quantity; it cannot (whereſoever it is found) have any other formal cause than quantity: and therefore either the two little parts of different Elements, do not become one body: or if they d , we must agree that it is by the nature of quantity which work.h as much in heterogeneal parts, as it doth in homogeneal ones. And it must needs do so: because Rarity and Density (which are the proper differences of Quantity) cannot change the common nature of Q antity, that is their Genus: which by being so to them, must be univocally in them both. And this effect cometh precisely from the pure notion of the Genus: and consequently, must be seen as well in two parts of diff:rent natures, as in two parts of the same nature: but in par s of the same nature, which once were two, and afterwards become on , there can be no other reason why they are one, than the very same: for which those parts that were never separated (but that may be separated) are likewise one: and this most evidently is the nature of quantity.

5. The third conjunction is of parts of different elements, and it proceedeth from quantity and density together.

Experience seem:th to confirm thus much; when pouring water out of a basin, some of it will remain sticking to the sides of the metal: for if the quantity of the basin, and of the water, had not been one and the same by its own nature; the water (considering the pliableness of its parts) would certainly have common all away, and have glided from the unevenness of the basin, by the attractive unity of its whole, and would have preserved the unity of its quantity within it self, rather than by sticking to the basin, have suffered division in its own quantity; which we are sure was one, whiles the water was altogether in the basin: but that, both the basin and the water making but one quantity; and a division being unavoidable in that one quantity; it was indifferent, in regard of the quantity considered singly

by it self, where this division should be made, whether in the parts of the basin, or in the parts of the water: and then, the other circumstances determined it in that part of the water which was neerest to the joyning of it with the basin.

The second eff & (which was resistance to divisibility;) we assigned unto density. And of that same cause, must also depend the like effect in this case of the sticking together of the two parts of different Elements, when they are joyned to one another: for if the two parts, whereof one is dense, the other is rare, do not exceed the quantity of some other part of one homogeneal rare Element, for the dividing whereof, such a determinate force, and no less can suffice; then, seeing that the whole composed of these two parts is not so divisible as the whole consisting of that one part, the assigned force will not be able to divide them. Wherefore it is plain, that if the rare part had been joyned to another rare part in stead of the dense one it is joyned unto, it had been more easily dividable from that than now it is from the dense part. And by consequence it sticketh more closely to the dense part, than it would to another of its own nature.

6. The reason why liquid bodies do easily joyn together, and dry ones difficulty.

Out of what we have said, a step is made us to understand why soft and liquid bodies do easily joyn and incorporate into one continued body; but hard and dry bodies so difficultly, as by experience we find to be true. Water with water, or wine either with other wine or with water, so uniteth, that it is very hard to part them: but sand or stones cannot be made to stick together without very great force and industry. The reasons whereof, must necessarily depend of what we have said above, To wit, that two bodies cannot touch one another, without becoming one: and, that if two bodies of one degree of density do touch, they must stick together according to the force of that degree of density. Out of which two, is manifestly inferred, that if two hard things should come to touch, they must needs be more difficultly separated than two liquid things. And consequently, they cannot come to touch, without as much difficulty, as that whereby they are made one.

7. That no two hard bodies can touch one another immediately.

But to deduce this more particularly; let us consider, that all the little surfaces, by which one hard body may be conceived to touch another (as for example, when a stone lieth upon a stone) must of necessity be either plain, or concave, or convex. Now if

if a plain superficies should be supposed to touch another plain one coming perpendicularly to it; it must of necessity be granted to touch it as soon in the middle as on the sides. Wherefore if there were any air (as of necessity there must be) betwixt the two surfaces before they touched; it will follow that the air which was in the middle must have fled quite out from between the two surfaces, as soon as any part of the surfaces do touch; that is, as soon as the air which was between the utmost edges of the surfaces did fly out; and by consequence it must have moved in an instant.

But if a plain surface be said to touch a convex surface; it toucheth it onely by a line, (as Mathematicians demonstrate) or onely by a point. But, to touch by a line or a point, is in truth, not to touch by the form or notion of Quantity (which requireth divisibility in all that belongeth unto it;) and by consequence among bodies it is not to touch; and so, one such surface doth not touch the other.

Now for a plain surface to touch a concave, every man seeth it impossible. Likewise for two convex surfaces to touch one another, they must be allowed to touch either in a line or in a point, which we have shewed not to be a physical touching. And if a convex surface should be said to touch a concave, they must touch all at once as we said of plain surfaces; and therefore the same impossibility will arise therein: so that it is evident, that no two surfaces moving perpendicularly towards one another, can come to touch one another, if neither of them yieldeth and changeth its hew.

Now then, if it be supposed that they come slidingly one over another in the same line; whereby, first the very tips of the edges come to touch one another; and still as you shoove the uppermost on forwards, and that it slideth over more of the nether surface, it gaineth to touch more of it. I say that neither in this case do they touch immediately one another: for as soon as the two first parts should meet, if they did touch, and that there were no air between them; they must presently become one quantity or body as we have declared; and must stick firmly together, according to their degree of density; and consequently could not be moved on without still breaking asunder at every impulse, as much of the massie body, as were already made one by their touching.

And if you should say they did not become one; and yet allow them to touch immediatly one another without having any air or fluid body between them; then if you suppose them to move onwards upon these terms; they would be changed locally, without any intrinsecal change: which in the book *De Mundo* (as we have formerly alleged) is demonstrated to be impossible.

There remaineth onely a third way for two hard surfaces to come together; which is, that first they should rest sloping one upon another, and make an angle where they meet (as two lines, that cut one another, do in their point of their intersection) and so contain as it were a wedge of air between them, which wedge they should lessen by little and little, through their moving towards one another at their most distant edges (whiles the touching edges are like immoveable centers that the others turn upon) till at length they shut out all the air, and close together, like the two legs of a compass.

But neither is it possible that this way they should touch, for after their first touch by one line (which neither is in effect a touching, as we have shewed) no other parts of them can touch, though still they approach nearer and nearer, until their whole surfaces do intirely touch at once: and therefore the air must in this case leap out in an instant a greater space, than if the surfaces came perpendicularly to one another; for here it must flie from one extremity to the other: whereas, in the former case, it was to go but from the middle to each side.

And thus it is evident that no two bodies can arrive to touch one another, unless one of them at the least have a superficies plyable to the superficies of the other; that is, unless one of them be soft, which is to be liquid in some degree. Seeing then, that by touching, bodies do become one; and that liquidity is the cause and means whereby bodies arrive to touch; we may boldly conclude, that two liquid bodies do most easily and readily become one; and next to two such, a liquid and a hard body, are sooneſt united: but two hard ones most difficultly.

8. How mixed bodies are framed in general.

To proceed then with our reflections upon the composition of bodies, and upon what resulteth out of the joyning and mixture of their first differences Rarity and Density; we see, how if a liquid substance happeneth to touch a dry body it sticketh easily there-

thereunto. Then consider, that there may be so small a quantity of such a liquid body, as it may be almost impossible for any natural agent to divide it farther into any less parts; and suppose that such a liquid part is between two dry parts of a dense body, and sticking to them both, becometh in the nature of a glew to hold them together: will it not follow out of what we have said, that these two dense parts will be as hard to be severed from one another, as the small liquid part by which they stick together is to be divided? So that, when the viscuous ligaments which in a body do hold together the dense parts, are so small and subtile, as no force we can apply unto them can divide them, the adhesion of the parts must needs grow then inseparable. And therefore, we use to moisten dry bodies, to make them the more easily be divided; whereas those that are overmoist are of themselves ready to fall in pieces. And thus you see how in general, bodies are framed.

9. The cause of the several degrees of solidity in mixed bodies.

Out of which discourse, we may ballance the degrees of solidity in bodies, for all bodies being composed of humid and dry parts, we may conceive either kind of those parts, to be bigger or lesser, or to be more rare or more dense. Now if the dry parts of any body be extreme little and dense; and the moist parts that joyn the dry ones together, be very great and rare; then that body will be very easie to be dissolved. But if the moist parts which glew together such extreme little and dense dry parts, be either lesser in bulk, or not so rare; then the body composed of them will be in a stronger degree of consistence. And if the moist parts which serve for this effect, be in an excess of littleness and withall dense; then, the body they compose will be in the highest degree of consistence that nature can frame.

On the other side; if you glew together great dry parts which are moderately dense and great, by the admixion of humid parts that are of the least size in bulk, and dense withall; then the consistence will decrease from the height of it, by how much the parts are greater, and the density less. But if unto dry parts of the greatest size, and in the greatest remissenes of density, you add humid parts that are both very great and very rare, then the composed body will prove the most easily dissolveable of all that nature affordeth.

10. The rule

After this, casting our eyes a little farther towards the com-

whereunto are reduced all the several combinations of Elements in compounding of mixed bodies.

position of particular bodies; we shall find still greater mixtures, the farther we go; for as the first and simplest compounded bodies, are made of the four Elements; so, others are made of these; and again a third sort of them: and so onwards, according as by motion the parts of every one are broken in sunder, and mingled with others. Those of the first order, must be of various tempers according to the proportions of the Elements, whereof they are immediately made. As for example, such a proportion of fire to the other three Elements, will make one kind of simple body, and another proportion will make another kind: and so throughout, by various combinations and proportions among all the Elements.

In the effecting of which work, it will not be amiss to look a little upon nature, and observe how she mingleth and tempereth different bodies one with another, whereby she begetteth that great variety of creatures which wee see in the world. But because the degrees of composition are infinite, according to the encrease of number, we will contain our selves within the common notions of excess in the four primary components; for if we should descend once to specifie any determinate proportions, we should endanger losing our selves in a wood of particular natures, which belong not to us at present to examine. Then taking the four Elements as materials to work upon: Let us first consider how they may be varied, that differing compositions may result out of their mixtures. I conceive that all the waies of varying the Elements in this regard, may be reduced to the several sizes of bigness, of the parts of each Element, that enter into the composition of any body, and to the number of those parts: for certainly no other can be imagined, unless it were variety of figure.

But that cannot be admitted to belong in any constant manner to those least particles whereof bodies are framed; as though determinate figures were in every degree of quantity due to the natures of elements, and therefore, the elements would conserve themselves in those figures, as well in their least atoms, as in massie bulk: for seeing how these little parts are shuffled together without any order; and that all liquids easily joyn, and take the figures which the dense ones give them; and that they again justling one anorher, do crush themselves into new shapes, which

which their mixture with the liquid ones, maketh them yeeld the more easily unto: it is impossible that the elements should have any other natural figure in these their least parts, than such as chance giveth them. But that one part must be bigger than another is evident; for the nature of rarity and density giveth it: the first of them causing divisibility into little parts, and the latter hindering it.

Having then setled in what manner the elements may be varied in the composition of bodies; let us now begin our mixture. In which our ground to work upon must be earth and water; for onely these two are the basis of permanent bodies, that suffer our senses to take hold of them, and that submit themselves to trial: whereas if we should make the predominant element to be air or fire, and bring in the other two solid ones under their jurisdiction to make up the mixture, the compound resulting out of them would be either in continual consumption (as ordinary fire is) or else imperceptible to our eyes or touch, and therefore not a fit subject for us to discourse of, since the other two afford us enough to speculate upon. Peradventure our smell might take some cognisance of a body so composed, or the effect of it taken in by respiration, might in time shew it self upon our health: but it concerneth not us now to look so far; our designe requireth more maniable substances.

11. Earth and water are the basis of all permanent mixed bodies.

Of which let water be the first; and with it we will mingle the other three elements, in excess over one another by turns; but still all of them overswayed by a predominant quantity of water: and then let us see what kind of bodies will result out of such proportions. First, if earth prevail above fire and air, and arrive next in proportion to the water, a body of such a composition must needs prove hardly liquid, and not easie to let its parts run asunder, by reason of the great proportion of so dense a body as earth that holdeth it together. Yet some inclination it will have to fluidness, by reason the water is predominant over all; which also will make it be easily divisible, and give very little resistance to any hard thing that shall be applied to make way through it. In a word, this mixture maketh the constitution of mud, dirt, honey, butter, and such like things where the main parts are great ones, And such are the parts of earth and water in themselves.

12. What kind of bodies those are, where water is the basis, and earth the predominant element over the other two.

Let

13. Of those bodies, where water being the basis, air is the predominant Element.

Let the next proportion of excess in a watery compound, be of air, which when it prevaileth, it incorporateth it self chiefly with earth, for the other Elements would not so well retain it. Now, because its parts are subtile (by reason of the rarity it hath) and sticking, (because of its humidity) it driveth the earth and water likewise into lesser parts. The result of such a mixture is, that the parts of a body compounded by it are close, catching, flowing, slowly glibb, and generally it will burn, and be easily converted into flame.

Of this kind, are those which we call oyly or unctuous bodies, whose great parts are easily separated, (that is, they are easily divisible in bulk,) but the small ones very hardly. Next the smalness, and well-working of the parts, by means of the airs penetrating every dense one, and sticking close to every one of them, and consequently, joyning them without any unevenness; causeth that there can be no ruggedness in it; and therefore, it is glib: in like manner as we see plaster or starch become smooth when they are well wrought. Then, the humidity of it causeth it to be catching, and the shortness of every part, maketh that where it sticketh, it is not easily parted thence. Now the rarity of air next unto fire, admitteth it to be (of all the other Elements) most easily brought to the height of fire, by the operation of fire upon it. And therefore, oyles are the proper food of that Element. And accordingly we see, that if a drop of oyl be spilled upon a sheet of paper, and the paper be set on fire at a corner; as the fire cometh near the oyl, the oyl will disperse and spread it self upon the paper to a broader compass than it had; which is because the heat rarifieth it; and so, in oyl it self, the fire rarifiyng the air, maketh it penetrate the earthy parts adioyned unto it, more than it did; and so subtilizeth them, till they be reduced to such a height as they are within the power of fire to communicate his own nature unto them: and thus, he turneth them into fire, and carrieth them up in his flame.

14. What kind of bodies result, where water is the basis, and fire the predominant Element.

But if fire be predominant over earth and air in a watry compound; it maketh the body so proportioned, to be subtile, rare, penetrative, hot in operation, light in weight, and subject to burn. Of this kind are all sorts of wines, and distilled spirits commonly called strong waters or Aquavites; *in Latine Aquæ ardentes.*

ardentes. Theſe will loſe their virtues meerly by remaining uncovered in the air; for fire doth not incorporate ſtrongly with water; but, if it find means, raiſeth it ſelf in the air; as we ſee in the ſmoak of boyling water, which is nothing elſe but little bodies of fire, that entring into the water, do rarifie ſome parts of it; but have no inclination to ſtay there, and therfore as faſt as they can get out, they fly away; but the humid parts of the water, which they have rarified (being of a ſticking nature) do joyn themſelves unto them, and aſcend in the air as high as the fiery atoms have ſtrength to carry them: which when it faileth them that ſmoke falleth down in a dew, and ſo becometh water again as it was. All which one may eaſily diſcern in a glaſs veſſel of water ſet over the fire; in which one may obſerve the fire come in at the bottom, and preſently ſwim up to the top like a little bubble, and immediately riſe from thence in ſmok; and that will at laſt convert it ſelf into drops and ſettle upon ſome ſolid ſubſtance thereabouts.

Of theſe fiery ſpirits, ſome are ſo ſubtile, as of themſelves they will vaniſh, and leave no reſidue of a body behind them; and Alchymiſts profeſs to make them ſo etherial and volatil, that being poured out of a glaſs from ſome reaſonable height, they ſhall never reach the ground: but that before they come thither they will be ſo rarified by that little motion, as they ſhall grow inviſible like the air, and diſperſing themſelves all about in it, they will fill the chamber with the ſmell of that body which can no longer be ſeen.

15. Of thoſe bodies, where water is in exceſs, it alone being both the baſis, and the predominant Element.

The laſt exceſs in watery bodies, muſt be of water it ſelf, which is, when ſo little a proportion of any of the other is mingled with it, as is hardly perceptible: out of this compoſition do ariſe all thoſe ſeveral ſorts of juices or liquors which we commonly call waters: which by their mixture with the other three Elements, have peculiar properties beyond ſimple Elemental water. The general quality whereof, we ſhall not need any further to expreſs, becauſe by what we have already ſaid of water in common, they are ſufficiently known.

16. Of thoſe bodies, where Earth alone is the baſis, and

In our next ſurvey, we wil take earth for our ground to work upon, as hitherto we have done water: wch if in any body, it be in the utmoſt exceſs of it beyond all the other three; then rocks and ſtones will grow out of it; whoſe drineſs and hardneſs may aſſure

also the predominant in excess over the other three Elements.

assure us, that earth swayeth in their composition, with the least allay that may be. Nor doth their lightness (in respect of some other earthy compositions) impeach this resolution; for that proceedeth from the greatness and multiplicity of pores, wherewith their driness causeth them to abound; and hindereth not, but that their real solid parts may be very heavy.

17. Of those bodies where earth is the basis, and water the predominant element over the other two.

Now if we mingle a considerable proportion of water with earth, so as to exceed the fire and air, but still inferior to the earth; we shall produce metals; whose great weight with their ductility and malleability, plainly telleth us, that the smalleft of waters gross parts, are the glew that holdeth the earthy dense ones together; such weight belonging to earth, and that easie changing of parts, being most proper to water. Quicksilver (that is the general matter whereof all the metals are immediately composed) giveth us evidence thereof; for fire worketh upon it with the same effect as upon water. And the calcination of most of the metals, proveth that fire can easily part and consume the glew by which they are closed and held together: which therefore must be rather of a watry than of an aiery substance. Likewise the glibness of Mercury, and of melted metals, without catching or sticking to other substances, giveth us to understand, that this great temper of a moist element with earth is water, and not air; and that the watry parts are comprised, and as it were shut up within the earthy ones: for air catcheth and sticketh notably to all things it toucheth, and will not be imprisoned; the divisibility of it being exceeding great, though in never so short parts.

18. Of those bodies, where earth being the basis, air is the predominant.

Now if air mingleth it self with earth and be predominant over water and fire, it maketh such an oily and fat soil, as husbandmen account their best mould; which receiving a better-ment from the sun and temperate heat, assureth us of the concourse of the air: for whersoever such heat is, air cannot fail of accompanying it, or of being effected in it; and the richest of such earth (as pot-earth and marl) will with much fire grow more compacted, and stick closer together than it did; as we see in baking them into pots or fine bricks. Whereas if water were the glew between the dense parts, fire would consume it, and crumble them asunder, as it doth in those bodies it calcineth. And excess of fire will bring them to vitrification; which still con-

confirmeth that air aboundeth in them; for it is the nature of air to stick so close where once it is kneaded in, as it cannot be separated without extream difficulty. And to this purpose the viscous holding together of the parts of glass when it is melted, sheweth evidently that air aboundeth in vitrified bodies.

19. Of those bodies where earth being the basis fire is the predominant.

The last mixture we are to meddle with, is of fire with earth, in an overruling proportion over air and water. And this I conceive produceth those substances, which we may term coagulated juices, and which the Latines do call *succi concreti*: whose first origine seemeth to have been liquors, that have been afterwards dried by the force either of heat or of cold. Of this nature are all kind of salts, niters, sulphurs, and divers sorts of bitumens. All which easily bewray the relicks and effects of fire left in them, some more, some less, according to their degrees.

20. All the second qualities of mixed bodies, arise from several combinations of the first qualites: and are at last resolved into several degrees of rarity and denfity.

And thus we have in general deduced from their causes the complexions of those bodies, whereof the bulk of the world subjected to our use, consisteth; and which serve for the production and nourishment of living creatures, both animal and vegetable. Not so exactly (I confess) nor so particularly, as the matter in it self, or as a Treatise confined to that subject, would require: yet sufficiently for our intent. In the performance whereof, if more accurate searchers of nature shall finde that we have peradventure been mistaken in the minute delivering of some particular bodies complexion; their very correction (I dare boldly say) will justifie our principal scope: which is, to shew that all the great variety we see among bodies ariseth out of the commixtion of the first qualities, and of the Elements: for they will not be able to correct us upon any other grounds than those we have laid.

As may easily be perceived, if we cast a summary view upon the qualities of composed bodies. All which we shall finde to spring out of rarity and denfity, and to savour of their origine: for the most manifest qualities of bodies may be reduced to certain pairs opposite to one another. As namely some are liquid and flowing, others are consistent; some are soft, others hard; some are fatty, viscuous, and smooth, others lean, gritty, and rough; some gross, others subtile; some tough, others brittle: and the like. Of which, the liquid, the soft, the fat, and the viscuous, are so manifestly derived from rarity, that we need not

take

take any further pains to trace out their origine: and the like is of their contraries from the contrary cause; to wit, of those bodies that are consistent, hard, lean, and gritty, all which do evidently spring from density. As for smoothness, we have already shewed how that proceedeth from an airy or oyly nature; and by consequence, from a certain degree of rarity. And therefore roughness (the contrary of it) must proceed from a proportionable degree of density. Toughness is also a kinde of ductility, which we have reduced to watrinesse, that is, to another degree of rarity; and consequently brittleness must arise from the contrary degree of density. Lastly, grossness and subtilness do consist in a difficulty or facility to be divided into small parts, which appeareth to be nothing else but a certain determination of rarity and density. And thus we see how the several complexions of bodies are reduced to the four elements that compound them: and the qualities of those bodies, to the two primary differences of quantative things by which the elements are diversified.

21. That in the planets and starsthere is a like variety of mixed bodies caused by light as here upon earth.

And out of this discourse it will be evident, that these complexions and qualities, though in diverse degrees, must of necessity be found wheresoever there is any variation in bodies: for seeing there can be no variation in bodies, but by rarity and density; and that the pure degrees of rarity and density do make heat, cold, moisture, and drineſs, and (in a word) the four elements; it is evident, that wheresoever there is variety of bodies, there must be the four Elements; though peradventure far unlike these mixed bodies which we call elements. And again, because these elements cannot consist without motion; and because by motion they do of necessity produce mixed bodies, and forge out those qualities which we come from explicating; it must by like necessity follow, that wheresoever there is any variety of active and passive bodies, there mixed bodies likewise must reside of the same kinds, and be indued with qualities of the like natures, as those we have treated of; though peradventure such as are in other places of the world remote from us, may be in a degree far different from ours.

Since then it cannot be denied, but that there must be notable variety of active and passive bodies wheresoever there *is light*: neither can it be denied but that in all those great bodies from which

which light is reflected unto us, there must be a like variety of complexions and of qualities, and of bodies tempered by them, as we finde here in the orb we live in. Which systeme, how different it is from that which *Aristotle* and the most of the School have delivered us, as well in the evidencies of the proofs for its being so; as in the position and model of it; I leave unto the prudent readers to consider and judge.

22. In what manner the elements do work upon one another, in the composition of mixed bodies: and in particular fire which is the most active.

Out of what hath been already said, it is not hard to discover in what manner the composition of bodies is made. In effecting of which, the main hinge whereon that motion dependeth is fire or heat: as it likewise is in all other motions whatsoever. Now because the composition of a mixed body, proceedeth from the action of one simple body or element upon the others; it will not be amisse to declare by some example how this work passeth: for that purpose let us examine how fire or heat worketh upon his fellows.

By what we have formerly delivered, it is clear that fire streaming out from its center, and diffusing it self abroad, so as to fill the circumference of a larger circle, it must needs follow, that the beams of it are most condensed and compacted together neer the center; and the farther they stream from the center, the more thin and rarified they must grow: yet this is with such moderation, as we cannot any where discern that one beam doth not touch another; and therefore the distances must be very small. Now let us suppose that fire happeneth to be in a viscous and tenacious body; and then consider what will happen in this case: of one side, the fire spreadeth it self abroad; on the other side, the parts of the tenacious body being moist (as we have formerly determined) their edges on all hands will stick fast to the dry beams of the fire that pass between them. Then they stretching wider and wider one from another, must needs draw with them the parts of that tenacious body which stick unto them; and stretch them into a greater wideness or largness than they enjoyed before, from whence it follows, that (seeing there is no other body neer thereabouts but they two) either there must be a vacuity left, or else the tenacious body must hold and fill a greater space than it did before, and consequently be more rare.

Contrariwise, if any of the other elements be stronger than fire, the denser elements break off from their continued stream the little

little parts of fire which were gotten into their greater parts, and sticking on all sides about them, they do so enclose them that they have no more semblance of fire: and if afterwards by any accident there cometh a great compression, they force them to lose their natural rarity, and to become some other Element. Thus it fareth with fire, both in acting and in suffering. And the same coerse, we have in both these regards expressed of it, passeth likewise in the rest of the Elements to the proportion of their contrarieties.

Hence it followeth, that when fire meeteth with humidity in any body, it divideth and subtiliseth it, and disperseth it gently, and in a kind of equal manner through the whole body it is in, (if the operation of it be a natural and a gentle one) and so driveth it into other parts, which at the same time it prepareth to receive it by subtilising likewise those parts. And thus moderate fire, maketh humor in very small parts to incorporate it self in an even or uniform manner with the dry parts it meeteth withall: which being done, whether the heat doth afterwards continue, or that cold succeedeth in lieu of it, the effect must of necessity be, that the body thus composed, be bound up and fastened, more or less, according to the proportion of the matter it is made of, and of the Agents that work upon it, and of the time they employ about it. This is every day seen, in the ripening of fruits, and in other frequent works, as well of art as of nature, and is so obvious, and sensible to any reasonable observation, that it is needless to enlarge my self much upon this subject.

23. A particular declaration touching the generation of metals.

Onely, it will not be amisse, for examples sake, to consider the progress of it in the composing or augmenting of metals, or of earths of divers sorts: first heat (as we have said) draweth humor out of all the bodies it worketh upon: then if the extracted humour be in quantity, and the steams of it do happen to come together in some hollow place, fit to assemble them into greater parts; they are condensed, and they fall down in a liquid and running body. These steams being thus corporified, the body resulting out of them, maketh it self in the earth a chanel to run in: and if there be any loose parts in the chanel, they mingle themselves with the running liquor: and though there be none such, yet in time the liquor it self looseneth the chanel all about, and imbibeth into its own substance

the

the parts it raiseth. And thus, all of them compacted together, do roll along till they tumble into some low place, out of which they cannot so easily get to wander farther. When they are thus settled, they do the more easily receive into them, and retain such heat as is every where to be met withall, because it is diffused more or less through the earth. This heat if it be sufficient digesteth it into a solid body: the temper of cold likewise concurring in its measure to this effect. And according to the variety of the substances whereof the first liquor was made, and which it afterwards drew along with it, the body that resulteth out of them is diversified. In confirmation of all which, they that deal in mines tell us they use to finde metals oftentimes mingled with stones; as also coagulated juices with both; and earth of divers natures with all three, and they with it, and one with another among themselves. And that sometimes they find the mines not yet consolidated and digested throughly into metal; when by their experience knowing after how many years they will be ripe, they shut them up again till then.

Now if the hollow place wherein the body staied (which at the first was liquid and rolling) be not at once filled by it, but it taketh up onely part of it, and the same liquor continueth afterwards to flow thither, then this body is augmented, and groweth bigger and bigger. And althongh the liquors should come at several times, yet they become not therefore two several bodies, but both liquors do grow into one body: for the wet parts of the adventitious liquor do mollifie the sides of the body already baked; and both of them being of a like temper and cognation, they easily stick and grow together.

Out of this discourse it followeth evidently, that in all sorts of compounded bodies whatsoever, there must of necessity be actually comprised sundry parts of divers natures: for otherwise, they would be but so many pure degrees of rarity and density; that is, they would be but so many pure elements, and each of them have but one determinate virtue or operation.

CHAP. XV.

Of the dissolution of mixed bodies.

THus much for composition of bodies. Their dissolution is made three waies; either by fire, or by water, or by some out- 1. Why some bodies are brittle

and others tough or apt to withstand outward violence, the first instrument to dissolve mixed bodies.

outward violence. We will begin with examining how this last is done: to which end we may consider, that the unity of any body consisting in the connexion of its parts; it is evident that the force of motion if it be exercised upon them, must of necessity separate them, as we see in breaking, cutting, filing, drawing asunder, and the like.

All these motions, because they are done by gross bodies, do require great parts to work upon, and are easily discerned how they work: so that it is not difficult to find the reason why some hard bodies break easily, and others with much ado. The first of which are called brittle, the others tough. For if you mark it, all breaking requireth that bending should precede; which on the other side compresseth the parts of the bended body, and condenseth them into a lesser room than they possessed before; and on the other side stretcheth them out, and maketh them take up more place. This requireth some fluid or movable substance to be within the body, else it could not be done; for without such help the parts could not remove. Therefore such hard bodies as have most fluid parts in them, are most flexible, that is, are toughest. And those which have fewest, though they become thereby hardest to have impression made upon them, yet if the force be able to do it, they rather yield to break than to bend, and thence are called brittle.

Out of this we may infer, that some bodies may be so suddenly bent as that thereby they break asunder; whereas if they were leisurely and gently dealt withall, they would take what ply one desireth. And likewise that there is no body (be it never so brittle and hard) but that it will bend a little (and indeed more than one would expect) if it be wrought upon with time and dexterity; for there is none but containeth in it some liquid parts more or less; even glass and brick. Upon which occasion I remember, how once in a great storm of wind, I saw the high slender brick chimneys of the Kings house at St. *James* (one winter when the Court lay there) bend from the wind like boughs, and shake exceedingly and totter. And at other times I have seen some very high and pointy spire steeples do the like. And I have been assured the like of the whole pile of a high castle, standing in a gullet in the course of the wind (namely the castle of *Wardour*) by those who have often seen it shake notably in a fierce wind.

The

The reason of all which may be deduced out of what we have said above: for seeing that the bending of a body maketh the spirits or humours that are within it to sally forth; it is clear that if the violence which forceth it be not so sudden, nor the motion it receiveth be not so quick, but that the moisture may loose gently out; the body will bend still more and more, as their absence giveth it leave. But if the motion that is wrought in it be too quick, then the spirits not having time allowed them to go leisurely and gently out, do force their prison, and break out with a violence, and so the body is snapped into two.

2. How outward violence doth work upon the most compacted bodies.

Here peradventure some remembring what we have said in another place; namely, that it is the shortness and littleness of the humid parts in a body which maketh it stick together; and that this shortness may be in so high a degree, as nothing can come between the parts they glew together to divide them; may ask, how a very dense body of such a strain, can be broken or divided? But the difficulty is not great, for seeing that the humid parts in whatsoever degree of shortness they be, must necessarily have still some latitude; it cannot be doubted but there may be some force assigned greater than their resistance can be. All the question is, how to apply it to work its effect upon so close a compacted body, in which peradventure the continuity of the humid parts that bind the others together, may be so small, as no other body whatsoever (no, not fire) can go between them, in such sort as to separate part from part. At the worst, it cannot be doubted but that the force may be so applied at the outside of that body, as to make the parts of it press and fight one against another, and at the length by multiplication of the force, constrain it to yield and suffer division. And this I conceive to be the condition of gold and of some precious stones: in which the elements are united by such little parts, as nothing but a civil war within themselves (stirred up by some subtile outward enemy, whereby they are made to tear their own bowels) could bring to pass their destruction.

But this way of dissolving such bodies, more properly belongs to the next way of working upon them by fire: yet the same is done when some exteriour violence pressing upon those parts it toucheth, makes them cut away betwixt their next neighbors; & so continuing the force divide the whole body. As when the chisel

or even the hammer with beating, breaketh gold asunder: for it is neither the chisel, nor the hammer that doth that effect immediately; but they make those parts they touch, cut the others that they are forced upon. In such sort as I remember happened to a gentleman that stood by me (in a sea-fight I was in) with a a coat of mail upon his body, when a bullet coming against a bony part in him, made a great wound, and shattered all the bones neer where it struck: and yet the coat of mail was whole: it seemeth the little links of the mail yielding to the bullets force made their way into the flesh and to the bone.

3. The several effects of fire, the second and chiefest instrument to dissolve all compounded bodies.

But now it is time to come to the other two instruments of separation of bodies, fire and water; and to examine how they dissolve compounds. Of these two; the way of working of fire, is the easiest and most apparent to be discerned. We may readily observe how it proceedeth, if we but set a piece of wood on fire; in which it maketh little holes as if with bodkins it pierced it. So that the manner of its operation in common being plain, we need but reflex a little upon the several particular degrees of it. Some bodies it seemeth not to touch; as clothes made of *Asbestus*; which are onely purified by it. Others, it melteth, but consumeth not; as gold. Others it turneth into powder, suddainly dissolving their body; as lead, and such metals as are calcined by pure fire. Others again, it separateth into a greater number of differing parts; as into spirits, waters, oyls, salts, earth and glass: of which rank are all vegetables. And lastly, others is converteth into pure fire; as strong waters, or Aquavites (called *aquæ ardentes*) and some pure oyls: for the smoak that is made by their setting on fire, and peradventure their salt is so little as is scarce discernable. These are in sum the divisions which fire maketh upon bodies, according to the nature of them, and to the due application of it unto them: for by the help and mediation of other things, it may peradventure work other effects

4. The reason why some bodies are not dissolved by fire.

Now to examine a little in particular, how the same fire, in differing subjects, produceth such different effects: *Limus ut hic duresçit, & hæc ut cera liquesçit, Uno eodémque igni*; —— We will consider the nature of every one of the subjects apart by it self. First, for the *Asbestus*: it is clear, that it is of a very dry substance; so that to look upon it, when it is broken into very little pieces, they seem to be little bundles of short hairs, the

the liquidity within, being so little as is affordeth the parts neither length nor breadth: and therefore, fire meeteth with little there that it can dilate. But what it cannot dilate, is cannot separate; nor carry away any thing of it, but what is accidentally adherent unto the outsides of it. And so it seemeth onely to pass through the pores, and to cleanse the little thrids of it: but bringeth no detriment at all to the substance of it. In this I speak onely of an ordinary fire: for I doubt not but such a one it might be, as would perfectly calcine it.

5. The reason why fire melteth gold, but cannot consume it.

The next body we spoke of is gold. This aboundeth so much in liquidity, that it sticketh to the fire, if duly applyed: but its humidity is so well united to its earthy parts, and is so perfectly incorporated with them, as it cannot carry away one, without likewise carrying away both: but both, are too heavy a weight for the little agile parts of fire to remove. Thus, it is able to make gold swell; as we see in melting it: in which, the gold receiveth the fire into its bowels, and retaineth it a long time with it: but at its departure, it permitteth the fire to carry nothing away upon its wings: as is apparent, by the golds no whit decay of weight, after never so long fusion. And therefore, to have fire make any separation in gold, requireth the assistance of some other moist body, that on the one side may stick closely to the gold, when the fire driveth it into it, and on the other side may be capable of dilatation, by the action of the fire upon it. As in some sort we see in strong waters made of salts, which are a proper subject for the fire to dilate, who, by the assistance of fire, mingling themselves closely with little parts of gold, do pull them away from their whole substance, and do force them to bear them company in their journey upwards, in which, multitudes of little parts of fire, do concurre to press them on and hasten them: and so, the weight of gold being at length overcome by these two powerfull Agents (whereof one supplieth, what the other wanteth) the whole substance of the metal, is in little atoms diffused through the whole body of the water. But this is not truly a dissolution or a separation of the substantial parts of gold, one from another: it is onely a corrosion, which bringeth it into a subtile pouder, (when the water & salts are separated from it) much like what filing (though far smaller) or grinding of leaf gold upon a porphyre stone, may reduce it into: for neither the

parts of the water, nor of the fire that make themselves a way into the body of the gold, are small and subtile enough to get between the parts that compose the essence of it: and therefore all they can attain unto, is to divide it onely in his quantity or bulk, not in the composition of its nature.

Yet I intend not to deny but that this is possible to be arrived unto, either by pure fire duly applyed, or by some other assistance; as peradventure by some kind of Mercury; which being of a neerer cognation unto metals than any other liquor is, may happily have a more powerfull ingression into gold, than any other body whatsoever; and being withall very subject to rarefaction, it may (after it is entered) so perfectly penetrate the gold, as it may separate every least part of it, and so reduce it into an absolute calx. But in this place I explicate no more than what ordinarily passeth, leaving the mysteries of this art to those who profess it.

6. Why lead is easily consumed and calcined by fire.

To go on then with what we have in hand: Lead hath abundance of water overmingled with its earth, as appeareth by its easie yielding to be bent any way, and by its quiet standing bent in the same position that the force which bowed it leaveth it in. And therefore the liquid parts of lead, are easily separated from its dry and earthy ones: and when is is melted the very shaking of it, causeth the gross parts to descend, and many liquid ones to fly away with the fire; so that suddenly it is thus converted into powder. But this powder is gross in respect of other metals; unless this operation be often reiterated, or the fire more powerfully applyed, than what is just enough to bring the body of the lead into powder.

7. Why and how some bodies are divided by fire into spirits waters, oils, salts, and earth. And what those parts are.

The next consideration of bodies that fire worketh upon, is of such as it divideth into spirits, salts, oyles, waters, or phlegms, and earth. Now these are not pure and simple parts of the dissolved body, but new compounded bodies made of the first by the operation of heat. As smoke is not pure water, but water and fire together: and therefore becometh not water but by cooling, that is, by the fire flying away from it. So likewise those spirits, salts, oyls, and the rest; are but degrees of things which fire maketh of diverse parts of the dissolved body, by separating them one from another, and incorporating it self with them. And so they are all of them compounded of the four elements, and are farther resolvable into them. Yet

Yet I intend not to say that there are not orignally in the body before its dissolution, some loose parts which have the properties of these bodies that are made by the fire in the dissolving of it: for seeing that nature worketh by the like instruments as art useth, she must needs in her accesses and defects produce like bodies to what art doth in dissolution; which operation of artis but a kind of excess in the progress of nature: but my meaning is, that in such dissolution there are more of these parts made by the working of fire, than were in the body before.

Now because this is the natural and most ordinary dissolution of things; let us see in particular how it is done: suppose then that fire were in a convenient manner applyed to a body that hath all sorts of parts in it; and our own discourse will tell us, that the first effect it worketh will be, that as the subtile parts of fire do divide and pass through that body, they will adhere to the most subtile parts in it; which being most agile and least bound and incorporated to the bowels of the body, and lying (as it were) loosely scattered in it, the fire will carry them away with it. These will be the first that are separated from the main body; which being retained in a fit receiver, will by the coldness of the circumdant air grow outwardly cool themselves, and become first a dew upon the sides of the glass, and then still as they grow cooler, condense more and more; till at the length they fall down congealed into a palpable liquour; which is composed (as you see) of the hottest parts of the body, mingled with the fire that carried them out: and therefore this liquour is very inflamable, and easily turned into actual fire, as you see all spirits and *Aquæ ardentes* of vegetables are.

The hot and loose parts being extracted, and the fire continuing and increasing, those that will follow next are such as though they be not of themselves loose, yet are easiest to be made so; and are therefore most separable. These must be humid, and those little dry parts which are incorporated with the overflowing humid ones in them (for no parts that we can arrive unto are of one pure simple nature; but all are mixed and composed of the four elements in some proportion) must be held together with such gross glew as the fire may easily penetrate and separate them. And then the humid parts divided into little atoms do stick to the lesser ones of the fire: which by their multitude

of number and velocity of motion, supplying what they want of them in bulk; do carry them away with them. And thus these phlegmatick parts flie up with the fire, and are afterwards congealed into an insipid water: which if it have any savour, is because the first ardent spirits are not totally separated from it, but some few of them remain in it, and give some little life to the whole body of that otherwise flat liquor.

Now those parts which the fire separateth next from the remaining body, after the fiery and watry ones are carried away, must be such as it can work upon: and therfore must abound in humidity. But since they stir not till the watry ones are gone, it is evident that they are composed of many dry parts strongly incorporated, and very subtilly mixed with the moist ones; and that both of them are exceeding small, and are so closely and finely knit together, that the fire hath much ado to get between them, and cut the thrids that tie them together: and therefore they require a very great force of fire to carry them up. Now the composition of these sheweth them to be aerial: and (together with the fire that is mingled with them) they congeal into that consistence which we call oyl.

Lastly, it cannot be otherwise but that the fire, in all this while of continual application to the body it thus anatomiseth, hath hardened, and as it were rosted some parts into such greatness and driness as they will not flie, nor can be carried up with any moderate heat. But great quantity of fire being mingled with the subtiler parts of his baked earth maketh them very pungent and acrimonious in tast: so that they are of the nature of ordinary salt, and are so called; and by the help of water may easily be separated from the more gross parts, which then remain a dead and useless earth.

By this discourse it is apparent, that fire hath been the instrument which hath wrought all these parts of an entire body into the forms they are in; for whiles it carried away the fiery part, it swelled the watry ones; and whiles it lifted up them it, digested the aerial parts; and whiles it drove up the oyls, it baked the earth and salt. Again, all these retaining for the most part, the proper nature of the substance from whence they are extracted; it is evident that the substance is not dissolved; (for so the nature of the whole would be dissolved & quite destroyed & extinguished in

in every part) but that onely some parts containing the whole substance, or rather the nature of the whole substance in them, are separated from other parts that have likewise the same nature in them.

The third instrument for the separation and dissolution of bodies is water, whose proper matter to work upon is salt. And it serveth to supply what the fire could not perform, which is the separation of the salt from the earth in calcined bodies. All the other parts fire was able to sever, but in these he hath so baked the little humidity he hath left in them with their much earth, as he cannot divide them any farther. And so though he incorporateth himself with them, yet he can carry nothing away with him. If then pure water be put upon that chalk, the subtileſt dry parts of it do easily joyn to the supervenient moisture, and sticking close to it do draw it down to them: but because they are the lighter, it happeneth to them as when a man in a boat pulleth the land to him; that cometh not to him, but he removeth himself and his boat to it: so these ascend in the water as they dissolve. And the water more and more penetrating them, and by addition of its parts making the humidity which gleweth their earthy parts together greater and greater, doth make a wider and wider separation between those little earthy parts; and so imbueth the whole body of the water with them, into which they are dispersed in little atoms. Those that are of biggest bulk remain lowest in the water. And in the same measure as their quantities dissolve into less and less, they ascend higher and higher in the water; till at the length the water is fully repleniſhed with them, and they are diffused through the whole body of it: whiles the more gross and heavy earthy parts (having nothing in them to make a present combination between them and the water) do fall down to the bottom, and settle under the water in dust.

8. How water the third instrument to dissolve bodies, dissolveth calx into salt, and so into *Terra damnata*.

In which because earth alone doth predominate in a very great exceſs, we can expect no other virtue to be in it, but that which is proper to meer earth; to wit, drineſs and weight. Which ordinary Alchymists look not after: and therefore call it *terra damnata*: but others find a fixing quality in it, by which they perform very admirable operations. Now if you pour the impregnated water from the *terra damnata*, and then evaporate

porate it, you will find a pure white substance remaining: Which by its bulk sheweth it self to be very earthly, and by its pricking, and corrosive taste, will inform you how much fire is in it, and by its easie dissolution in a moist place, that water had a great share in the production of it. And thus the salts of bodies are made and extracted.

6. How water mingled with salt, becometh a most powerfull Agent to dissolve other bodies.

Now as water doth dissolve salt, so by the incorporation and virtue of that corrosive substance it doth more than salt it self can do: for having gotten acrimony, and more weight by the mixture and dissolution of salt in it, it maketh it self a way into solid bodies, even into metals; as we see in brass and iron; which are easily rusted by salts dissolving upon them. And according as the salts are stronger, so this corrosive virtue encreaseth in them, even so much, as neither silver nor gold are free from their eating quality. But they, as well as the rest, are divided into most small parts, and are made to swim in water in such sort as we have explicated above, and whereof every ordinary Alchymist teacheth the practise.

But this is not all; salts do help as well to melt hard bodies and metals, as to corrode them: for some fusible salts flowing upon them by the heat of the fire, and others dissolved by the steam of the metal that incorporateth with them; as soon as they are in flux, they mingle with the natural juice of the metal, and penetrate them deeper, than without them the fire could do, and swell them and make them fit to run.

10. How putrifaction is caused.

These are the principals wayes of the two last instruments in dissolving of bodies; taking each of them by it self. But there remaineth one more of very great importance, as well in the works of nature as of art; in which, both the former are joyned and do concur: and that is putrifaction. Whose way of working is by gentle heat and moisture to wet and pierce the body it worketh upon; whereby, it is made to swell: and the hot parts of it, being loosened, they are at length drunk up and drowned in the moist ones (from whence, by fire they are easily separated, as we have already declared;) and those moist parts afterwards leaving it, the substance remaineth dry, and falleth in pieces for want of the glew that held it together.

CHAP.

CHAP. XVI.

An explication of certain Maxims touching the operations and qualities of bodies: and whether the Elements be found pure in any part of the world.

OUt of what we have determined, concerning the natural actions of bodies, in their making and destroying one another, it is easie to understand the right meaning of some terms, and the true reason of some maxims much used in the schools. As first; when Philosophers attribute unto all sorts of corporeal agents, *a sphere of Activity*. The sense of that manner of expression, in fire appeareth plainly, by what we have already declared of the nature and manner of operation of that Element. 1. What is the sphere of activity in corporeal Agents.

And in like manner, if we consider how the force of cold consisteth in a compression of the body that is made cold, we may perceive, that if in the cooled body there be any subtile parts which can break forth from the rest, such compression will make them do so. Especially, if the compression be of little parts of the compressed body within themselves, as well as of the outward bulk of the whole body round about: for at first the compression of such causeth in the body, where they are, little holes or pores in the places they are compressed and driven from; which pores they filled up when they were dilated at their own natural liberty. But being thus forcibly shrunk up into less room, afterwards, they squeese again out of their croud all such very loose and subtile parts (residing till then with them) as can find their way out from among them. And these subtile parts that thus are delivered from the colds impression, get first into the pores that we have shewed were made by this compression. But they cannot long stay there; for the atoms of advenient cold that obsess the compressed body, do likewise with all their force throng into these pores, and soon drive out the subtile guests they find there, because they are more in number, bigger in bulk, and more violent in their course than they. Who therefore must yield unto them the little chanels, and capacities they formerly took up. Out of which they are thrust with such an impetuosity, that they spin from them with a vehemence, as quick-

quicksilver doth through leather, when to purifie it, or to bring an Amalgame to a due consistence, it is strained through the sides of it.

Now these showers or streams of atoms issuing from the compressed body, are on all sides round about it at exceeding little distances; because the pores out of which they are driven, are so likewise. And consequently, there they remain round about besieging it, as though they would return to their original homes, as soon as the usurping strangers that were too powerfull for them, will give them leave. And according to the multitude of them, and to the force with which they are driven out; the compass they take up round about the compressed body, is greater or lesser. Which besieging atoms are not so soon carried away by any exterior and accidental causes, but they are supplied by new emanations succeeding them out of the said compressed body.

Now this which we have declared by the example of cold, compressing a particular body, hapneth in all bodies whersoever they be in the world: for this being the unavoidable effect of heat and of cold, wheresoever they reside; (which are the active qualities, by whose means not onely fire and water and the other two Elements, but all other mixed bodies composed of the Elements, have their activity) and they being in all bodies whatsoever (as we have proved above) it followeth evidently, that there is not a body in the world, but hath about it self an orb of emanations of the same nature which that body is of. Within the compass of which orb, when any other body cometh that receiveth an immutation by the little atoms whereof that orb is composed, the advenient body seemeth to be affected and as it were replenished with the qualities of the body from whence they issue. Which is then said to work upon the body that imbibeth the emanations that flow from it. And because this orb (regularly speaking) is in the form of a sphear, the passive body is said to be within the sphear of the others activity.

2. The reason why no body can work in distance.

Secondly, when Philosophers pronounce, that *No corporeal nature can operari in distans*; that is, that no body can work upon another remote from it, without working first upon the body that lieth between them, which must continue and piece up the operation from the agent to the patient. The reason and truth of this maxim is in our Philosophy evident; for we having shewed

shewed that action among bodies is performed for the most part by the emission of little parts out of one body into another: as also, that such little parts cannot stream from the body that is their fountain, and settle upon a remote body, without passing through the interjacent bodies; which must furnish them, as it were, with chanels and pipes to conveigh them whither they are to go; It followeth manifestly, that the active emissaries of the working body, can never reach their distant mark, unless they be successively ferried over the *medium*, that lieth between them; in which, they must needs leave impressions of their having been there, and so work upon it in their passage, and leave in it their qualities and complexions; as a paiment for their waftage over.

3. An objection answered against the manner of explicating the former axiom:

But peradventure some may contend, that these invisible serjeants and workmen are too feeble and impotent to perform those visible great effects we daily see. As when fire at the length burneth a board that hath been a great while opposed to it, though it touch not the body of the fire; or when a loadstone draweth unto it a great weight of iron that is distant from it.

Unto whom we shall reply, that if he will not grant these subtile emanations from the agent body, to be the immediate workers of these effects; he must allot that efficacy unto the whole corpulency of all the Agent working in bulk (for besides the whole, and the parts, there is no third thing to be considered in bodies; since they are constituted by quantity;) but the whole cannot work otherwise than by local motion: which in this case it cannot do, because by the suppositon, it is determined to keep its distance from the passive body, and not to move towards it. Therefore, this is impossible; whereas the other can appear but difficult at the worst, and therefore must be admitted, when no better and more intelligible solution can be found.

But withall we must note, that it is not our intention to say, but that it may in some circumstances hapen that some particular action or effect may be wrought in a remote part or body, which shall not be the same in the intermediate body that lieth between the agent and the patient, and that conveigheth the agents working atoms to the others body. As for example, when tinder or naphtha is by fire made to burn at a yard distance from it, when the interjacent air is but warmed by that fire. Or when the sun, by means of a burning-glass or of some other reflection, setteth some

some bodies on fire, and yet onely enlighteneth the glass and the air that are in the way. The reason of which is manifest to be the divers dispositions of the different subjects in regard of the Agent: and therefore it is no wonder that divers effects should be produced according to those divers dispositions.

4. Of reaction, and first in pure local motion, that each Agent must suffer in acting and act in suffering.

A third position among Philosophers is, that all bodies which work upon others, do likewise as the same time, wherein they work, suffer from those they work upon: and contrariwise that all bodies which suffer from others, do at the same time work back again upon them. For the better understanding whereof, let us consider that all action among bodies is either purely local motion, else local motion with certain particularities which give it a particular name. As when we express the local motion of little atoms of fire, or of earth, or water upon and into other bodies by the words of heating or cooling; and so of the like. Now if the action be pure local motion, and consequently the effect produced by that action be meerly change of place; we must call to mind how two dense bodies moving one against the other, do each of them bear before them some little quantity of a rarer body immediately joyned unto them: and consequently, these more rare bodies must be the first to feel the power of the dense bodies, and to receive impressions from their motions; each of them, by the opposite rare body, which like an huissier goeth before to make way for his following master that obligeth him to this service.

Now when these rare ushers have struggled a while like the first lightly-armed ranks of two armies in the interjacent field between their main battails, that follow them close at the heels, they must at the length yield, when they are overborn by a greater weight than they can sustain; and then they recoil back, as it were to save themselves by getting in among the files of dense bodies that drove them on; which not opening to admit them, and yet they still flying violently from the mattering force that pursueth them; they press so hard upon what at the first prest them on, as notwithstanding their density and strength they force them to retire back: for unless they do so, they are not of the number of those that work upon one another.

And this retiring, is either on both sides, or but of one side; If both, then it is evident how each of them it an Agent, and each of

of them a sufferer; each of them overcoming his opposite in such sort, as himself likewise receiveth blows and loss. But if onely one of the dense bodies be so shocked as to recoil back, then that onely suffereth in its body, and the other suffereth onely in its virtue; that is, in the air or other rare body it sendeth before it; which it driveth with such a violence, that it mastereth and quelleth the opposition of the other body, before it can reach to shake the dense body, before which it runneth. Yet that rare body must be pressed and broken into, in some measure, by the incounter of the other (which though never so weak, yet maketh some resistance) but much more when it cometh to grapple with the dense body it self: and so between them, it is wounded and infeebled, like those souldiers that first enter a breach in a town, from whence when they have driven the enemy, they pursue him to the cittadel, and force him from thence too; and so how maimed soever they prove, they make a free and easie way without resistance for the whole body of their army to follow them, and take quiet possession of that which did cost them so much to win.

And thus we see how it may happen that one of these moving bodies doth not suffer so much as to be staied in its journey; much less, to be driven back. And yet the other body at the same time work in some measure upon it, by working upon what is next to it; which recoiling against it must needs make some impression upon it, since there can be no opposition but must have some effect. Now this impression or effect, though it be not preceptible by causing a contrary motion, yet it must needs infeeble the virtue of the conquering Agent, and deaden the celerity of its motion. And thus it is evident, that in all pure local motions of corporeal Agents, every one of them must in some proportion suffer in acting, and in suffering must act.

5. The former doctrine applied to other local motions designed by particular names. And that Suisseths argument is of no force against this way of doctrine.

And what we have said of this kind of action, may easily be applied to the other where the effect of local motion is designed by a particular name, as it is in the examples we gave of heating and cooling. And in that, the proceeding will appear to be the very same as in this; for if fire doth heat water, the water reacteth again, either upon the fire and cooleth it, if it be immediate unto it; or else upon the interjacent air, if it be at a distance from the fire. And so the air is in some measure cooled, by the cold atoms that issue from the water, whose compass or sphear of

of activity being lesser than the fires, they cannot cool so far off, as the others can heat: but where they do arrive, they give their proportion of cold, in the very midst of the others army of fiery atoms, notwithstanding their multitude and violence.

According to which doctrine, our countryman *Suisseth* his argument, that in the schools is held insoluble, hath not so much as any semblance of the least difficulty: for it is evident that such atoms of fire and of water as we determine heat and cold to be, may pass and croud by one another into the subjects they are sent unto by divers little streams without hindering one another (as we have declared of air and light) and each of them be received in their own nature and temper by the same subject; though sense can judge onely according to which of them is predominant, and according to the proportion of its superiority.

Upon which occasion we cannot chuse but note, how the doctrine of qualities is not onely unable to give account of the ordinary and plain effects of nature; but also useth to end in cleer impossibilities and contradictions if it be driven far: as this argument of *Suisseth* sheweth, and many others of the like nature.

6. Why some notions do admit of intention and remission; and others do not.

A fourth position among Philosophers is, that some notions do admit the denominations of Intension and Remission, but that others do not. The reason of which we shall clearly see, if we but consider how these terms of *intension and remission*, do but express *more or less* of the thing that is said to be intended or remitted: for the nature of more and less doth imply a latitude and divisibility; and therefore cannot agree with the nature of such things as consist in an indivisible being. As for example, to be a *whole* or to be an *equal*, cannot be sometimes more, sometimes less; for they consist in such a rigorous indivisible being, that if the least part imaginable be wanting, it is no longer a *whole*, and if there be the least excess between two things, they are no longer equal, but are in some other proportion than of equality in regard of one another.

And hence it is that *Aristotle* teacheth us that *substance* and the species of Quantity, do not admit of intension and remission; but that Quality doth. For first in *substance*, we know that the signification of this word is, that which maketh a thing be what it is, as is evident by our giving it for an answer to the question what a thing is. And therefore, if there were any divisibility

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in substance, it would be in *what* the thing is; and consequently, every division following that divisibility, would make the thing another *what*, that is another thing. And so the substance that is pretended to be changed by intension or remission, would not be divided, as is supposed, but would cease to be, and another substance would succeed in the room of it. Whereby you see that every mutation in substance, maketh a new thing: and that more and less in quiddity cannot be pronounced of the same thing.

Likewise in quantity, it is clear that its Species do consist in an indivisible: for as in numbers, ten lions (for example) or ten Elephants are no more in regard of multitude than ten flees or ten motes in the sun; and if you add or take any thing from ten, it is no more ten, but some other number: so likewise in continued extension, a span, an ell, an ounce, or any other measure whatsoever, ceaseth to be a span and the rest, if you add to it or diminish from it the least quantity imaginable. And peradventure, the same is also of figures, as of a sphear, a cube, a circle, a square, &c. though they be in the rank of qualities.

But if we consider such qualities as heat, cold, moisture, drines, softness, hardness, weight, lightness, and the like; we shall find that they may be in any body sometimes more, sometimes less, (according as the excess of any Element or mixture is greater in it, at one time than at another) and yet the body in which these qualities are intended or remitted, remain still with the same denomination. As when dust continueth still soft, though sometimes it be less soft, other whiles softer; and wax remaineth figurable, whether it be melted or congealed; and wood is still hot, though it lose or gain some degree of heat.

But such intension in any subject whatsoever hath its determinate limits that it cannot pass; for when more of that quality that we say is intended (that is, more of the atoms of the active body) is brought into the body that suffereth the intension, than its complexion can brook; it resigneth its nature to their violence, and becometh a new thing; such an one as they are pleased to make it. As when wood, with extremity of heating (that is, with bringing into it so many atoms of fire, that the fire is stronger in it than its own nature) is converted into fire, smoke, water, and ashes; and nothing remaineth of the nature of wood.

7. That in every

But before we end this chapter, we may remember how in the close

part of our habitable world; all the four Elements, are found pure in small atoms; but not in any great bulk.

of the fourth we remitted a question concerning the existence of the Elements; (that is, whether in any places of the world there were any pure Elements, either in bulk or in little parts;) as being not ready to resolve it, till we had declared the manner of working of bodies one upon another. Here then will be a fit place to determine that, out of what we have discoursed concerning the actions, whereby bodies are made and corrupted: for considering the universal action of fire that runneth through all the bodies we have commerce withall, by reason of the suns influence into them and operation upon them with his light and beams which reacheth far and neer; and looking upon the effects which we have shewed do follow thence: it is manifest, there can not be any great quantity of any body whatsoever, in which fire is not intrinsecally mixed. And on the other side, we see that where fire is once mixed it is very hard to separate it totally from thence. Again, we see it is impossible that pure fire should be conserved, without being adjoyned to some other body; both because of its violent nativity, still streaming forth with a great impetuosity; as also because it is so easily overcome by any obsident body when it is dilated. And therefore we may safely conclude, that no simple Element can consist in any great quantity in this course of nature which we live in and take a survey of. Neither doth it appear to what purpose nature should have placed any such storehouses of simples, seeing she can make all needful complexions by the dissolutions of mixed bodies into other mixed bodies savouring of the nature of the Elements, without needing their purity to begin upon.

But on the other side it is as evident that the Elements must remain pure in every compounded body in such extreme small parts as we use to call atoms: for if they did not, the variety of bodies would be nothing else, but so many degrees of rarity and density, or so many pure homogeneal Elements, and not bodies composed of heterogeneal parts: and consequently would not be able to shew that variety of parts which we see in bodies, nor could produce the complicated effects which proceed from them. And accordingly we are sure that the least parts which our senses can arrive to discover have many varieties in them: even so much that a whole living creature (whose organical parts must needs be of exceeding different natures) may be so little, as unto

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our eyes to seem indivisible; we not distinguishing any difference of parts in it without the help of a multiplying glass: as in the least kind of mites, and in worms picked out of childrens hands we daily experience. So as it is evident that no sensible part can be unmingled. But then again, when we call to mind how we have shewed that the qualities which we find in bodies do result out of the composition, and mixtion of the Elements, we must needs conclude, that they must of necessity remain in their own essences in the mixed body. And so out of the whole discourse, determine that they are not there in any visible quantity, but in those least atoms, that are too subtile for our senses to discern. Which position we do not understand so Metaphysically as to say that their substantial forms remain actually in the mixed body; but onely that their accidental qualities are found in the compound; remitting that other question unto Metaphysicians (those spiritual Anatomists) to decide.

CHAP. XVII.

Of Rarefaction and Condensation, the two first motions of particular bodies.

OUr intention in this discourse, concerning the natures and motions of bodies, aiming no farther than at the discovery of what is or may be done by corporeal Agents; thereby to determine what is the work of immaterial and spiritual substances; it cannot be expected at our hands that we should deliver here an intire and compleat body of natural Philosophy. But onely that we should take so much of it in our way, as is needful to carry us with truth and evidence to our journeys end. It belongeth not then to us to meddle with those sublime contemplations which search into the nature of the vast Universe, and that determine the unity and limitation of it; and that shew by what strings, and upon pins, and wheels, and hinges, the whole world moveth: and that from thence do ascend unto an awful acknowledgement and humble admiration of the primary cause; from whence, and of which, both the being of it, and the beginning of the first motion, and the continuance of all others doth proceed and depend.

1. The Authours intent in this and the following chapters.

Nor indeed would it be to the purpose for any man to sail in

this Ocean, and to begin a new voyage of navigation upon it: unless he were assured, he had ballast enough in his ship to make her sink deep into the water, and to carry her steddily through those unruly waves; and that he were furnished with skill and provision sufficient to go through, without either losing his course by steering after a wrong compass, or being forced back again with short and obscure relations of discoveries: since others that went out before him, are returned with a large account to such as are able to understand and sum it up. Which surely our learned countreyman, and my best and most honoured friend, and to whom of all men living I am most obliged (for to him I owe that little which I know; and what I have, and shall set down in all this discourse, is but a few sparks kindled by me at his great fire) hath both profoundly, and acutely, and in every regard judiciously performed in his Dialogues of the world.

Mr *Thomas White.*

Our task then (in a lower strain, and more proportionate to so weak shoulders) is to look no farther than among those bodies we converse withal. Of which, having declared by what course and engines nature governeth their common motions, that are found even in the Elements, and from thence are derived to all bodies composed of them; we intend now to consider such motions as accompany divers particular bodies, and are much admired by whosoever understandeth not the causes of them.

3.

That bodies may be rarified, both by outward and inward heat; and how this is performed.

To begin from the easiest and most connexed with the actions of the Elements, the handsel of our labour will light upon the motions of *Rarefaction and Condensation*, as they are the passions of mixed bodies. And first for Rarefaction; we may remember how it proceedeth originally from fire, and dependeth of heat; as is declared in the former chapter: and whersoever we finde Rarefaction, we may be confident the body which suffereth it, is not without fire working upon it. From hence we may gather, that when the air imprisoned in a baloon or bladder, swelleth against what containeth it, and stretcheth its case, and seeketh to break out, this effect must proceed from fire or heat (though we see not the fire) working either within the very bowels of the air, or without, by pressing upon what containeth it, and so making it self a way unto it.

And that this latter way is able to work this effect, may be

be convinced by the contrary effect from a contrary cause: for take a bladder stretched out unto its greatest extent by air shut up within it; and hang it in a cold place; and you will see it presently contract it self into a less room; and the bladder will grow wrinkled, and become too big for the air within it. But for immediate proof of this position, wee see that the addition of a very small degree of heat, rarifieth the air in a weather glass, (the air receiving the impression of heat, sooner than water) and so maketh it extend it self into a greater place; and consequently, it presseth upon the water; and forceth it down into a less room than formerly it possessed. And likewise we see quicksilver and other liquours, if they be shut up in glasses close stopped and set in sufficient heat (and a little is sufficient for this effect) they will swell and fill their glasses; and at the last break them, rather than not find a way to give themselves more room; which is then grown too straight in the glass, by reason of the rarefaction of the liquors by the fire working upon them.

Now again; that this effect may be wrought by the inward heat, that is enclosed in the bowels of the substance thus shut up; both reason and experience do assure us: for, they teach us that if a body which is not extremely compacted, but that by its looseness is easily divisible into little parts (such a one as wine, or other spiritual liquors) be inclosed in a vessel; the little atoms that perpetually move up and down in every space of the whole world, making their way through every body, will set on work the little parts, in the wine for example, to play their game: so that the hot and light parts (if they be many) not enduring to be compressed and kept in by the heavie and cold ones, do seek to break out with force; and till they can free themselves from the dense ones that would imprison them they carry them along with them, and make them to swell out as well as themselves.

Now if they be kept in by the vessel, so that they have not play enough; they drive the dense ones (like so many little hammers or wedges) against the sides of it, and at the length do break it, and so do make themselves way, to a larger room. But if they have vent, the more fiery hot spirits fly away, and leave the other grosser parts quiet and at rest. On the other side, if the hot and light parts in a liquor be not many nor very active, and the vessel be so full that the parts have not free scope to remove

and make way for one another, there will not follow any great effect in this kind: as we see in bottled beer or ale, that worketh little, unless there be some space left empty, in the bottle. And again; if the vessel be very much too big for the liquor in it, the fiery parts find room, first to swell up the heavy ones, and at the length to get out from them, though the vessel be close stopped; for they have scope enough to float up and down between the surface of the liquor, and the roof of the vessel.

And this is the reason that if a little beer or small wine be left long in a great cask, be it never so close stopped, it will in time grow dead. And then, if at the opening of the bung (after the cask hath been long unstirred) you hold a candle close to it, you shall at the instant see a flash of flame environing the vent; Which is no other thing, but the subtile spirits that parting from the beer or wine, have left it dead; and flying abroad as soon as they are permitted, are set on fire by the flame that they meet with in their journey, as being more combustible (because more subtile) than that spirit of wine which is kept in form of liquour: and yet that likewise (though much grosser) is set on fire by the touch of flame. And this happeneth not onely to wine, and beer, or ale, but even to water; As dayly experience sheweth in the East-Indian ships, that having been 5 or 6 years at sea, when they open some of their casks of Thames-water in their return homewards (for they keep that water till the last, as being their best and most durable, and that groweth lighter, and purer, by the often putrifyings through violent motions in storms, every one of which maketh new gross and earthy parts fall down to the bottom, and other volatile ones ascend to the top;) a flame is seen about their bungs if a candle be near, as we said before of wine.

And to proceed, with confirming this doctrine by farther experience; we dayly see that the little parts of heat being agitated and brought into motion in any body, they enter and pierce into other parts, and incorporate themselves with them, & set them on fire if they be capable thereof: as wee see in wet hay or flax laid together in great quantity. And if they be not capable of taking fire, then they carry them with them to the outside; & when they can transport them no farther, part flies away, & other part staies with

with them: as we see in new beer or ale, & in must of wine; in wch, a substance usually called the mother, is wrought up to the top.

Which in wine, will at the last be converted into Tartar, when the spirits that are very volatile, are flown away, and do leave those parts from whence they have evaporated, more gross and earthy than the others, where the grosse and subtiler parts continue still mixed. But in beer, or rather in ale, this mother, which in them we call barm, wil continue longer in the same consistence and with the same qualities; for the spirits of it are not so fiery that they must presently leave the body they have incorporated themselves withall; nor are hot enough to bake it into a hard consistence. And therefore bakers make use of it to raise their bread; which neither it will do, unless it be kept from cold; both which, are evident signes that it works in force of heat; and consequently, that it continueth still a hot and light substance.

And again we see, that after wine or beer hath wrought once, a violent motion will make it work anew. As is dayly seen in great lightnings and in thunder, and by much rocking of them; for such motion rarifieth, and consequently heateth them: partly by separating the little parts of the liquour, which were before as glewed together, and therefore lay quietly; but now, by their pulling asunder, and by the liquors growing thereby more loose than it was, they have freedome to play up and down: and partly by beating one part against another, which breaketh and divideth them into lesser atoms, & so bringeth some of them into the state of fire; which you may remember, is nothing else but a body brought into such a degree of littlenes and rarity of its parts.

And this is the reason why such hard and dry bodies as have an unctuous substan ce in them, are by motion either easily set on fire, or at the least, fire is easily gotten out of them. As happeneth in flints, and in divers other stones, which yeeld fire when they are strucken; and if presently after you smell unto them, you shall perceive an odour of brimstone and of burning, which is a certain signe that the motion did convert into fire the natural brimston that was mingled with the flint, and whose denser parts were grown cold, and so stuck to the stone. And in like manner, the ivywood and divers others, as also the Indian canes (which from thence are called firecanes) being rubbed with some other stick of the same nature, if they be first very dry, will

of themselves set on fire: and the like will happen to coach-wheels in the summer if they be overheated with motion.

3. Of the great effects of Rarefaction.

To conclude our discourse of rarefaction, we may look a little into the power and efficacity of it, which is no where to be seen so clearly as in fire. And as fire is the general cause of rarefaction, so is it of all bodies that which is most rarefied. And therefore it is no marvail if its effects be the greatest that are in nature, seeing it is the proper operation of the most active Element. The wonderfull force of it we dayly see in thunder, in guns, in granadoes, and in mines; of which, continuall experience, as well as several histories witnesseth little less than miracles. Leaving them to the remarks of curious persons, we will onely look into the way by which so main effects do proceed from causes that appear so slender.

It is evident that fire (as we have said before) dilateth it self spherically; as nature sheweth us manifestly in bubbles of boyling water, and of milk, and generally of such substances as are of a viscuous composition; for those bubbles being round, do assure us that the cause which made them, did equally dilate them from the center unto all parts. Now then remembring the infinite multiplication which is in fire, we may conceive that when a grain of gun-powder is turned thereinto, there are so many little bubbles of a viscuous substance one backing another with great celerity, as there are parts of fire more than there were of gun-powder. And if we make a computation of the number and of the celerity of these bubbles, we shall find that although every one of them single do seem to be of an inconsiderable force, yet the whole number of them together, will exceed the resistance of the body moved or broken by them: especially, if we note, that when hard substances have not time allowed them to yield, they break the sooner. And then we shall not so much admire the extremities we see acted by these means.

4. The first manner of condensation, by heat.

Thus having looked into the nature of rarefaction, and traced the progress of it from the motion of the sun and fire; in the next place we are to examine the nature of condensation. And we shall often-times finde it likewise an effect of the same cause otherwise working: for there being two different wayes to dry any wet thing; the one, by taking away that juyce which maketh a body liquid; the other, by putting more drought to the wet body,

dy, that it may imbibe the moisture; this latter way doth, as well as the former, condense a body: for by the close sticking of wet to dry, the moist part of condensation is effected in compounded bodies.

The first of these waies, doth properly and immediately proceed from heat; for heat entring into a body, incorporateth it self with the moist and viscous parts it findeth there: as purging medicines do with the humours they work upon; which when the stomack can no longer entertain (by reason of their unruly motions in restling together) they are both ejected grappling with one another; and the place of their contention is thus, by the supervenience of a guest of a contrary nature (that will not stay long there) purged from the superabundance of the former ones that annoyed it. Even so, the fire that is greedily drunk up by the watry and viscuous parts of a compounded body; and whose activity and restless nature will not endure to be long imprisoned there, quickly pierceth quite through the body it entereth into, and after a while streameth out at the opposite side, as fast as it entered in on the side next to it, and carrieth away with it those glewy parts it is incorporated with: and by their absence, leaveth the body they part from, dryer than at the first it was.

Which course we may observe in sirrups that are boyled to a consistence, and in broths that are consumed unto a jelly: over which, whiles they are making by the fire under them, you see a great steam; which is, the watry parts that being incorporated with fire, flie away in smoke. Likewise when the sea-water is condensed into salt, you see it is an effect of the sun or fire that exhalteth or boylteth away all the palpable moisture. And so when wet cloths are hanged either in the sun or at the fire, we see a smoke about the cloths, and heat within them; which being all drawn out from them, they become dry.

And this deserveth a particular note, that although they should be not quite dry, when you take them from the fire; yet by then they are cool, they will be dry: for the fire that is in them when they are removed from the main stock of fire, flying away, carrieth with it the moisture that was incorporated with it: and therfore whiles they were hot, that is, whiles the fire was in them they must also be moist; because the fire and the moisture were

grown

grown to be one body: & could not becom through dry with that measure of fire, (for more would have dryed them, even whiles they were hot) untill they were also grown through cold. And in like manner, sirupes, hydromels, gellies, and the like, grow much thicker after they are taken off from the fire, than they were upon the fire, and much of their humidity flieth away with the fire, in their cooling, whereby they lessen much of their quantity, even after the outward fire hath ceased from working upon them.

Now if the moist parts, that remain after the drying, be by the heat well incorporated in the dry parts; and so do occasion the dry parts to stick close together; then that body is condensed, and will (eo the proportion of it) be heavier in a less bulk; as we see that metals are heavier than stones.

5. The second manner of condensation by cold.

Although this effect be in these examples wrought by heat, yet generally speaking it is more proper to cold: which is the second way of drying a moist body. As when in *Greenland* the extreme cold freeseth the whalefishers beer into ice, so that the stewards divide it with axes and wedges, and deliver their portions of drink to their ships company, and their shallopes gings in their bare hands: but in the innermost part of the butt, they find some quantity of very strong liquor, not inferior to moderate spirits of wine. At the first, before custome had made it familar unto them, they wondered that every time they drew at the tap, when first it came from their ships to the shore (for the heat of the hold would not let it freez) no liquor would come, unless they new tapped it with a longer gimlet: but they thought that pains well recompensed, by finding it by the taste to grow stronger and stronger, till at the last, their longest gimlets would bring nothing out; and yet the vessel not a quarter drawn off; which obliged them then to stave the cask, that so they might make use of the substance that remained.

The reason of this, is evident: that cold seeking to condense the beer by mingling its dry and cold parts with it, those that would indure this mixture, were imbibed and shrunk up by them. But the other rare and hot parts that were squeesed out by the dense ones which entered to congeal the beer, and were forced into the middle of the vessel (which was the fartheft part for them to retire unto, from their inviroining enemies) did conserve

serve themselves in their liquid form, in defiance of the assaulting cold; whiles their fellows, remaining by their departure more gross and earthy than they were before, yeelded to the conquerour, they could not shift away from, and so were dryed and condensed in ice: which when the mariners thawed, they found it like fair water, without any spirits in it, or comforting heat to the stomack.

This manner of condensation, which we have described in the freezing of beer, is the way most practised by nature; I mean, for immediate condensation (for condensation is secondarily, wheresoever there is rarefaction, which we have determined to be an effect of heat.) And the course of it is: that a multitude of earthy and dry bodies being driven against any liquour, they easily divide it, by means of their density, their dryness and their littleness (all which in this case do accompany one another, and are by us determined to be powerfull dividers;) and when they are gotten into it, they partly suck into their own pores the wet and diffused parts of the liquid body; and partly they make them (when themselvs are full) stick fast to their dry sides, and become as a glew to hold themselves strongly together. And thus they dry up the liquor; and by the natural pressing of gravity they contract it into a lesser room. No otherwise than when we force much wind or water into a bottle; and by pressing it more and more, make it lie closer than of its own nature it would do. Or rather, as when ashes being mingled with water, both those substances do stick so close to one another, that they take up less room than they did each apart.

This is the method of frosts, and of snow, and of ice, both natural and artificial; for in natural freezing, ordinarily the north or north-east wind by its force bringeth and driveth into our liquours, such earthy bodies as it hath gathered from rocks covered with snow; which being mixed with the light vapours whereof the wind is made, do easily find a way into the liquors, and then they dry them into that consistence which we call ice. Which in token of the wind it hath in it, swimmeth upon the water, and the vessel where it was made, riseth higher than the water did whereof it is composed: and ordinarily it breaketh from the sides of the vessel, so giving way to more wind to come in, and freeze deeper and thicker.

But

3. That yce is not water rarified but condenſed.

But becauſe *Galileus*, *Nel diſcorſo intorno alle coſe che ſtanno in ſu l' acqua*, *pag.* 4 was of opinion that yce was water rarified, and not condenſed; we muſt not paſs over this verity, without maintaining it againſt the oppoſition of ſo powerfull an adverſary. His arguments are, firſt that yce taketh up more place than the water did of which it was made; which is againſt the nature of condenſation. Secondly, that quantity for quantity yce is lighter than water; whereas things that are more denſe are proportionally more heavy. And laſtly, that yce ſwimmeth in water, whereas we have often taught, that the more denſe deſcendeth in the more rare.

Now to reply to theſe arguments, we ſay firſt, that we would gladly know how he did to meaſure the quantity of the yce, with the quantity of the water of which it was made; & then when he hath ſhewed it, and ſhewed withall that yce holdeth more place than water; we muſt tell him that his experiment concludeth nothing againſt our doctrine, becauſe there is an addition of other bodies mingled with the water to make yce of it, as we touched above; and therefore that compound may well take up a greater place than the water alone did, and yet be denſer than it; and the water alſo be denſer than it was.

And that other Bodies do come into the water and are mingled with it, is evident out of the exceeding coldneſs of air, or ſome very cold wind; one of which two never miſſeth to reign whenſoever the water freezeth: and both of them do argue great ſtore of litle earthy dry bodies abounding in them, which ſweeping over all thoſe that lie in their way and courſe, muſt of neceſſity be mixed with ſuch as give them admittance, which water doth very eaſily. And accordingly we ſee that when in the freezing of water the yce groweth any thing deep, it either ſhrinketh about the borders, or at the leaſt lieth very looſe, ſo as we cannot doubt but that there is a free paſſage for more of ſuch ſubtile bodies to get ſtill to the water, and freez it deeper.

To his ſecond argument, we ask how he knoweth that yce quantity for quantity, is lighter than water? for although of a ſpunge that is full of water, it be eaſie to know what the ſpunge weigheth, and what the water that was ſoked into it, becauſe we can part the one of them from the other, and keep each apart to examine their weights, yet to the like between yce and water,

water, if ice be throughout full of air (as of necessity it must be) we believe impossible. And therefore it may be lighter in the bulk than water, by reason of the great pores caused in it, through the shrinking up of the parts of water together (which pores must then necessarily be filled with air) and yet every part by it self (in which no air is) be heavier than so much water.

And by this it appeareth that his last argument (grounded upon the swimming of ice in water) hath no more force than if he would prove that an iron or an earthen dish, were lighter, and consequently more rare than water, because it swimmeth upon it; which is an effect of the airs being contained in the belly of it (as it is in ice) not a sign of the metals being more rare than water.

Whereas on the contrary side, the proof is positive and clear for us; for it cannot be denied, but that the mingling of the water with other bodies more dense than it, must of necessity make the compound and also the water it self become more dense than it was alone. And accordingly we see, that ice half thawed (for then much of the air is driven out, and the water beginneth to fill the pores wherein the air recided before) sinketh to the bottom: as an iron dish with holes in it (whereby the water might get into it) would do. And besides, we see that water is more diaphanous than ice, and ice more consistent than water. Therefore I hope we shall be excused, if in this particular we be of a contrary opinion to this great personage.

7. How wind, snow, and hail are made; and wind by rain allaied.

But to return unto the thrid of our discourse. The same that passeth here before us, passeth also in the sky with snow, hail, rain, and wind. Which that we may the better understand, let us consider how winds are made: for they have a main influence into all the rest. When the Sun by some particular occurrent raiseth great multitudes of atoms from some one place, and they either by the attraction of the Sun, or by some other occasion, do take their course a certain way; this motion of those atoms we call a wind: which according to the continuance of the matter from whence these atoms rise, endureth a longer or a shorter time, and goeth a farther or a shorter way, like a river, or rather like those eruptions of waters, which in the Northern parts of *England* they call *Gypsies*: the which do break out at uncertain times, and upon uncertain causes, and flow likewise with an

an uncertain duration. So these winds being composed of bodies in a determinate proportion heavier than the air, do run their course from their height to the ground, where they are supported (as water is by the floor of its chanel) whiles they perform their carreer; that is, until they be wasted either by the drawing of the sun, or by their sticking and incorporating into grosser bodies.

Some of these winds according to the complexion of the body out of which they are extracted, are dry; as those which come from barren mountains covered with snow: others are moist; as those that come out of marishy or watry places: others have other qualities; as of heat, or cold, of wholsomness, or unwholsomness, and the like; partly from the source, and partly from the bodies they are mingled with in their way.

Such then being the nature and origine of winds: if a cold one do meet in the air with that moist body whereof otherwise rain would have been made, it changeth that moist body into snow or into hail; if a dry winde meet with a wet body it maketh it more dry, and so hindreth the rain that was likely to be: but if the wet body overcome the dry wind, it bringeth the wind down along with it; as we see when a shour of rain allaieth a great winde.

And that all this is so, experience will in some particulars instruct us as well as reason, from whence the rest may be evidently inferred. For we see that those who in imitation of nature would convert water into ice, do take snow or ice & mingle it with some active dry body, that may force the cold parts of the snow from it; and then they set the water (in some fit vessel) in the way that those little bodys are to take, which by that means entring into it, do strait incorporat themselves therewith, & of a sudden do convert it into ice. Which process you may easily try, by mingling salt armoniak with the snow; but much more powerfully by setting the snow over the fire, whiles the glass of water to be congealed stands in it after the manner of an egge in salt. And thus fire it self, though it be the enemy and destroyer of all cold, is made the instrument of freezing. And the same reason holdeth in the cooling of wine with snow or ice, when after it hath been a competent time in the snow, they whose charge it is, do use to give the vessel that containeth the wine, three or four turns in the snow; so to mingle through the whole body of the wine, the cold

cold received first but in the outward parts of it, and by pressing, to make that without have a more forcible ingression.

But the whole doctrine of *Meteors* is so amply, so ingeniously, and so exactly performed by that never enough praised Gentleman *Monsieur Des Cartes* in his Meteorological discourses; as I should wrong my self and my Reader, if I dwelled any longer upon this subject. And whose Physical discourses, had they been divulged before I had entred upon this work, I am perswaded would have excused the greatest part of my pains in delivering the nature of bodies.

8. How parts of the same or divers bodies are joyned more strongly together by condensation.

It were a fault to pass from treating of condensation, without noting so ordinary an effect of it as is the joyning together of parts of the same body, or of divers bodies. In which we see for the most part that the solid bodies which are to be joyned together, are first either heated or moistened, that is, they are rarified: and than they are left to cold air or to other cold bodies to thicken and condense (as above we mentioned of sirrups and jellies;) and so they are brought to stick firmly together. In the like manner we see that when two metals are heated till they be almost brought to running, and then are pressed together by the hammer, they become one continued body. The like we see in glass, the like in wax, and in divers other things. On the contrary side; when a broken stone is to be pieced together, the pieces of it must be wetted, and the ciment must be likewise moistened, and then joyning them aptly, and drying them, they stick fast together. Glew is moistened, that it may by drying afterwards hold pieces of wood together. And the spectacle-makers have a composition which must be both heated and moistened, to joyn unto handles of wood the glass which they are to grined. And broken glasses are cimented with cheese and chalk or with garlick.

All these effects our sense evidently sheweth us, arise out of condensation; but to our reason it belongeth to examine particularly by what steps they are performed. First then we know that heat doth subtilize the little bodies which are in the pores of the heated body; and partly also it openeth the pores of the body it self, if it be of a nature that permitteth it; as it seemeth those bodies are, which by heat are mollified or are liquefactible. Again, we know that moisture is more subtile to enter into small creeks than

than dry bodies are; especially when it is pressed; for then it will be divided into very little parts, and will fill up every little chink; and nevertheless if it be of a gross and viscuous nature, all the parts of it will stick together. Out of these two properties we have, that since every body hath a kind of orb of its own exhalations, or vapors round about it self (as is before declared,) the vapors which are about one of the bodies, will more strongly and solidly (that is, in more abundant and greater parts) enter into the pores of the other body against which it is pressed when they are opened and dilated: and thus they becoming common to both bodies, by flowing from the one, and streaming into the other, and sticking to them both, will make them stick to one another. And then as they grow cold and dry, these little parts shrink on both sides; and by their shrinking draw the bodies together; and withall do leave greater pores by their being compressed together, than were there when by heat and moisture they were dilated; into which pores the circumstant cold parts do enter, and thereby do as it were wedge in the others; and consequently do make them hold firmly together the bodies which they joyn.

But if art or nature should apply to this juncture any liquor or vapor, which had the nature and power to insinuate it self more efficaciously to one of these bodies, than the glew which was between them did; of necessity in this case these bodies must fall in pieces. And so it happeneth in the separation of metals by corrosive waters; as also in the precipitation of metals or of salts when they are dissolved in such corrosive waters, by means of other metals or salts of a different nature: in both which cases the entrance of a latter body that penetrateth more strongly, and uniteth it self to one of the joyned bodies, but not to the other, teareth them asunder, and that which the piercing body rejecteth, falleth into little pieces; and if formerly it were joyned with the liquor, it is then precipitated down from it in a dust.

9. Vacuities cannot be the reason why water impregnated to the full with one kind of salt, will notwithstanding receive more of another.

Out of which discourse we may resolve the question of that learned and ingenious man *Petrus Gassendus*; who by experience found, that water impregnated to fulness with ordinary salt, would yet receive a quantity of other salt; and when it would imbibe no more of that, would nevertheless take into it a proportion of a third; and so of several kinds of salts one after

ter another: which effect he attributed to vacuities or porous ſpaces of divers figures, that he conceived to be in the water; whereof ſome were fit for the figure of one ſalt, and ſome for the figure of another. Very ingeniouſly; yet if I miſs not my mark moſt aſſuredly he hath miſſed his.

For firſt, how could he attribute divers ſorts of vacuities to water without giving it divers figures? And this would be againſt his own diſcourſe, by which every body ſhould have one determinate natural figure.

Secondly, I would ask him if he meaſured his water after every ſalting? and if he did, whether he did not find the quantity greater, than before that ſalt was diſſolved in it? Which if he did (as without doubt he muſt) then he might ſafely conclude that his ſalts were not received in vacuities; but that the very ſubſtance of the water gave them place, and ſo encreaſed by the receiving of them.

Thirdly, ſeeing that in his doctrine every ſubſtance hath a particular figure; we muſt allow a ſtrange multitude of different ſhapes of vacuities to be naturally in water; if we will have every different ſubſtance wherewith it may be impregnated (by making decoctions, extractions, ſolutions, and the like) to find a fit vacuity in the water to lodge it ſelf in. What a difform net with a ſtrange variety of maſhes would this be? And indeed how extremely uncapable muſt it be of the quantity of every various kind of vacuity that you will find muſt be in it; if in every ſolution of one particular ſubſtance, you calculate the proportion between it and the water that diſſolveth it, and then multiply it according to the number of ſeveral kinds of ſubſtances that may be diſſolved in water? By this proceeding, you will find the vacuities to exceed infinitely the whole body of the water; even ſo much that it could not afford ſubtile thrids enough to hold it ſelf together.

Fourthly, if this doctrine were true it would never happen that one body or ſalt ſhould precipitate down to the bottom of the water, by the ſolution of another in it, which every Alchymiſt knoweth, never faileth in due circumſtances: for ſeeing that the body which precipitateth, and the other which remaineth diſſolved in the water, are of different figures, and therefore do require different vacuities, they might both of them have kept their pla-

ces in the water, without thrusting one another out of it.

Lastly, this doctrine giveth no account why one part of salt is separated from another by being put in the water, and why the parts are there kept so separated, which is the whole effect of that motion which we call dissolution.

10. The true reason of the former effects.

The true reason therefore of this effect, is (as I conceive) that one salt maketh the water apt to receive another; for the lighter salt being incorporated with the water, maketh the water more proper to stick unto an heavier, and by dividing the small parts of it to bear them up, that otherwise would have sunk in it. The truth and reason of which will appear more plain, if at every joynt we observe the particular steps of every salts solution. As soon as you put the first salt into the water, it falleth down presently to the bottom of it; and as the water doth by its humidity pierce by degrees the little joynts of this salt, so the small parts of it are by little and little separated from one another, and united to parts of water. And so infusing more and more salt, this progress will continue, until every part of water is incorporated with some part of salt: and then, the water can no longer work of it self but in conjunction to the salt with which it is united. After which, if more salt of the same kinde be put into the water, that water so impregnated, will not be able to divide it; because it hath not any so subtile parts left, as are able to enter between the joynts of a salt so closely compacted: but may be compared to that salt, as a thing of equal drinesse with it; and therefore is unapt to moisten and pierce it.

But if you put into this compound of salt and water, another kind of salt that is of a stronger and a drier nature than the former, and whose parts are more grossly united; then the first salt dissolved in the water, will be able to get in betwixt the joynts of the grosser salt, and will divide it into little parts; and will incorporate his already composed parts of salt and water into a decompound of two salts and water; until all his parts be anew impregnated with the second grosser salt; as before, the pure water was with the first subtiler salt. And so it will proceed on, if proportionate bodies be joyned, until the dissolving composition do grow into a thick body.

Unto which discourse we may add, that when the water is so fully impregnated with the first salt, as it will receive no more,

maining in the temper it is in; yet if it be heated, it will then a-freſh diſſolve more of the ſame kind. Which ſheweth, that the reaſon of its giving over to diſſolve, is for want of having the water divided into parts little enough to ſtick unto more ſalt: which, as in this caſe the fire doth; ſo peradventure in the other, the acrimonioufneſs of the ſalt doth it.

And this is ſufficient to give curious wits occaſion by making farther experiments, to ſearch out the truth of this matter. Onely we may note what hapneth in moſt of the experiencies we have mentioned; to wit, that things of the ſame nature do joyn better and more eaſily than others that are more eſtranged from one another. Which is very agreeable to reaſon; ſeeing that if nature do intend to have things conſiſt long together, ſhe muſt fit them for ſuch conſiſtence. 11. The reaſon why bodies of the ſame nature do joyn more eaſily together than others.

Which ſeemeth to proceed out of their agreement in four qualities; firſt, in weight: for bodies of divers degrees in weight, if they be at liberty, do ſeek divers places; and conſequently ſubſtances of like weight, muſt of neceſſity finde one another out, and croud together; as we have ſhewed, it is the nature of heat to make them do: now it is apparent that things of one nature, muſt in equal parts have the ſame or a neer proportion of weight, ſeeing that in their compoſition, they muſt have the ſame proportion of Elements.

The ſecond reaſon of the conſiſtence of bodies together, that are of the ſame nature, is, the agreement of their liquid parts, in the ſame degree of rarity and denſity: for as it is the nature of quantity in common to make all parts be one quantity; ſo it is the nature of the degrees of quantity, when two parts do meet that are of the ſame degree, to make them one in that degree of quantity; which is, to make them ſtick together in that degree of ſticking, which the degree of denſity that is common to them both, maketh of its own nature. Whereas, parts of different denſities, cannot have this reaſon of ſticking: though, peradventure they may upon ſome other ground, have ſome more efficacious one. And in this manner, the like humid parts of two bodies, becoming one, the holes or receptacles in which thoſe humid parts are contained muſt alſo needs be united.

The third reaſon is the agreeable proportion, which their ſeveral figures have in reſpect of one another: for if any humidi-

ty be extracted out of a mixed body, especially, by the virtue of fire; it must have left pores of such figures, as the humidity that is drawn out of them, is apt to be cut into (for every humid body not being absolutely humid, but having certain dry parts mixed with it, is more apt for one kind of figure and greatness, than for another;) and by consequence, whensoever that humidity shall meet again with the body it was severed from, it will easily run through and into it all, and will fill exactly the cavities and pores it possessed before.

The last quality, in which bodies that are to consist long together, do agree, is the bigness of the humid and dry parts of the same body: for if the humid parts be too big for the dry ones, it is clear that the dry ones must needs hang loosely together by them; because their glew is in too great a quantity. But if the humid parts be too little for the dry ones, then of necessity some portion of every little dry part must be unfurnish'd of glew, by means whereof to stick unto his fellow; and so the sticking parts not being conveniently proportioned to one another, their adhesion cannot be so solid as if each of them were exactly fitted to his fellow.

CHAP. XVIII.

Of another motion belonging to particular bodies, called Attraction; and of certain operations, termed Magical.

1. What Attraction is, and from whence it proceedeth.

HAving thus ended the two motions of rarefaction and of condensation; the next that offer themselves, are the local motions which some bodies have unto others. These are sometimes performed by a plain force in the body towards which the motion is: and other whiles by a hidden cause, which is not so easily discerned. The first, is chiefly that which is ordinarily said to be done by the force of nature to hinder *vacuum*, and is much practised by nature; as in drawing our breath, in sucking, and in many other natural operations, which are imitated by art in making of pumps, syphons, and such other instruments; and in that admirable experiment of taking up a heavy marble stone meerly by another lying flat and smoothly upon it, without any other connexion of the two stones together; as also by that sport of boyes, when they spread a thin moistned leather upon a smooth broad stone, and press it all over close to it, and then by pulling of a string fastned at the middle of the

leather,

leather, they draw up likewise the heavy stone. In all which, the first cause of the motion proceedeth from that body towards wch the motion is made. And therefore is properly called *Attraction*.

For the better understanding and declaring of which, let us suppose two marble stones, very broad and exceeding smoothly polished to be laid one flat upon the other: and let there be a ring fastned at the back part of the uppermost stone; and exactly in the middle of it. Then by that ring, pull it up perpendicularly and steadily, and the undermost will follow sticking fast to the overmost; and though they were not very perfectly polish.d, yet the nethermost would follow for a while, if the ring be suddenly plucked up; but then it will soon fall down again. Now this plainly sheweth that the cause of their sticking so strongly together, when both the stones are very well polished, is for that nothing can well enter between them to part them; and so, it is reduced to the shortness of the air that is betwixt them: which not being capable of so great an expansion, nor admitting to be divided thick-waies so much as is necessary to fill the first growing distance, between the two stones, till new air findeth a course thither (that so, the swelling of the one, may hinder vacuity, till the other come into the rescue;) the two stones must needs stick together to certain limits; which limits will depend of the proportion that is between the weight, and the continuity of the nethermost stone.

3. The true sense of the Maxim, that *Nature abhorreth vacuity*.

And when we have examined this, we shall understand in what sense it is meaned that *Nature abhorreth from Vacuity*, and what means she useth to avoid it. For, to put it as an enemy that nature fighteth against; or to discourse of effects that would follow from it, in case it were admitted, is a great mistake, and a lost labour; seeing it is nothing; and therefore, can do nothing: but is meerly a form of expression to declare in short nothing else but that it is a contradiction, or implication in terms, and an impossibility in nature, for vacuity to have, or be supposed to have a *Being*.

Thus then, since in our case, after we have cast all about, we can pitch upon nothing to be considered, but that the two stones do touch one another, and that they are weighty; we must apply our selves onely to reflect upon the effects proceeding from these two causes, their contiguity and their heaviness; and we shall finde

that as the one of them, namely the weight, hindereth the undermoſt from following the uppermoſt, ſo, contiguity obligeth it unto that courſe; and according as the one overcometh the other, ſo will this action be continued or interrupted.

Now that contiguity of ſubſtances do make one follow another, is evident by what our Maſters in Metaphyſicks teach us; when they ſhew that without this effect no motion at all could be made in the world, nor no reaſon could be given, for thoſe motions we daily ſee. For ſince the nature of quantity is ſuch, that whenſoever there is nothing between two parts of it, they muſt needs touch and adhere and joyn to one another, (for how ſhould they be kept aſunder when there is nothing between them to part them?) if you pull one part away, either ſome new ſubſtance muſt come to be cloſe unto that which removeth; or elſe the other which was formerly cloſe to it, muſt ſtill be cloſe to it, and ſo follow it: for if nothing do come betweeen, it is ſtill cloſe to it. Thus then, it being neceſſary that ſomthing muſt be joyned cloſe to every thing; vacuity, (which is nothing) is excluded from having any being in nature.

And when we ſay that one body muſt follow another to avoid vacuity; the meaning is, that under the neceſſity of a contradiction they muſt follow one another, and that they cannot do otherwiſe. For it wou'd be a contradiction to ſay that nothing were between two things and yet that they are not joyned cloſe to one another. And therefore if you ſhould ſay it, you would in other words ſay, they are cloſe together, and they are not cloſe together. In like manner, to ſay that vacuity is any where, is a pure contradiction; for vacuity being nothing hath no *Being* at all: and yet by thoſe words it is ſaid to be in ſuch a place; ſo that they affirm it *to be* and *not to be*, at the ſame time.

3. The true reaſon of attraction.

But now let us examine if there be no means to avoid this contradiction and vacuity, other than by the adheſion, and following of one body upon the motion of another, that is cloſely joyned to it and every where contiguous. For ſenſe is not eaſily quieted with ſuch *Metaphyſical* contemplations, that ſeem to repugn againſt her dictaments; and therefore for her ſatisfaction we can do no leſs than give her leave to range about, and caſt all waies in hope of finding ſome one that may better content her: which when ſhe findeth that ſhe cannot ſhe will the leſs repine

to

to yield her assent to the rigorous sequels and proofs of reason.

In this difficulty then, after turning on every side, I for my part can discern no pretence of probability, in any other means than in pulling down the lower stone by one corner; that so there may be a gaping between the two stones, to let in air by little and little. And in this case you may say that by the intervention of air, vacuity is hindered, and yet the lower stone is left at liberty to follow its own natural inclination, and be governed by its weight. But indeed, if you consider the matter well, you will find that the doing this, requireth a much greater force, than to have the lower stone follow the upper: for it cannot gape in a straight line, to let in air; since in that position, it must open at the bottom where the angle is made, at the same time that it openeth at the mouth: and then air requiring time to pass from the edges to the bottom, it must in the mean while fall into the contradiction of vacuity. So that if it should open to let in air; the stone, to compass that effect, must bend, in such sort as wood doth when a wedge is put into it to cleave it.

Judge then what force it must be that should make hard marble of a great thickness bend like a wand; and whether it would not rather break and slide off, than do so: you will allow that a much less, will raise up the lower stone together with the uppermost. It must then of necessity fall out, that it will follow it, if it be moved perpendicularly upwards. And the like effect will be though it should be raised at oblique angles, so that the lowermost edge do rest all the way upon something that may hinder the inferiour stone from sliding aside from the uppermost.

And this is the very ease of all those other experiments of art and nature, which we have mentioned above: for the reason holdeth as well in water and liquid things; as in solid bodies, until the weight of the liquid body overcometh the continuity of it: for then, the thrid breaketh, and it will ascend no higher.

4. Water may be brought by the force of attraction to what height soever.

Which height, *Galileo* telleth us from the workmen in the *Arsenal* of *Venice*, is 40. foot; if the water be drawn up in a close pipe, in which the advantage of the sides helpeth the ascent. But others say that the invention is inlarged, and that water may be drawn to what height one pleaseth. Howsoever, the force which nature applieth to maintain the continuity of quantity, can have no limit, seeing it is grounded upon contradiction.

And therefore *Galileo* was much mistaken, when he thought to make an instrument whereby to discover the limits of this force.

We may then conclude, that the breaking of the water must depend from the strength of other causes. As for example, when the gravity is so great by increasing the bulk of the water, that it will either overcome the strength of the pipe, or else make the sucker of the pump rather yield way to air, than draw up so great a weight: for which defects, if remedies be found, the art may surely be inlarged without end.

5. The doctrine touching the attraction of water in syphons.

This is particular in a syphon; that when that arm of it which hangeth out of the water is lower than the superficies of the water; then, it will run of it self; after it is once set on running by sucking. The reason whereof is, because the weight which is in the water pendant, is greater than the weight of the ascending water; and thereby supplieth the want of a continual sucker. But if the nose of that arm that hangeth out of the water, be but even, with the water; then the water will stand still in both pipes, or arms of the syphon, after they are filled with sucking. But if by the running out of the water, the outward pipe do grow shorter than to reach as low as the superficies of the water in the fountain from whence it runneth; in this case, the water in each arm of the syphon, will run back into the fountain.

Withall, it is to be noted, that though the arm which is out of the water be never so long, yet if it reach not lower than the superficies of the fountain; the overquantity and weight of the water there, more than in the other arm, helpeth it nothing to make it run out. Which is, because the declivity of the other arm over-recompenceth this over-weight. Not that the weight in the shorter pipe hath so much force as the weight in the longer pipe: but because it hath more force than the greater weight doth exercise there in its running; for the greatest part of its force, tendeth another way than to the end of the pipe; to wit, perpendicularly towards the center. And so is hindered from effect, by the great sloping or little declivity of the pipe upon which it leaneth.

6. That the syphon doth not prove water to weigh in its own orb.

But some considering how the water that is in the longe arm of the syphon is more in quantity than the water that is in the other arm of it whereat it runneth out, do admire why the greater quantity of water doth not draw back the less into the

cistern

ciſtern, but ſuffereth it ſelf to be lifted up, and drained away as if it run ſteeply downwards. And they imagine, that hence may be deduced, that the parts of water in the ciſtern do not weigh as long as they are within the orb of their own body.

Unto whom we anſwer; that they ſhould conſider how that to have the greater quantity of water, which is in the longer arm of the ſyphon (which arm is immerſed in the water of the ciſtern) to draw back into the ciſtern the water which is in the other arm of the ſyphon that hangeth out in the air; it muſt, both raiſe as much of the water of the ciſtern as its own bulk is, above the level which at preſent the whole bulk of water hath; and withall it muſt at the ſame time pull up the water which is in the other arm. Now it is manifeſt, that theſe two quantities of water together, are heavier than the water in the ſunk arm of the ſyphon; ſince one of them ſingle, is equal unto it. And by conſequence, the more water in the ſunk arm cannot weigh back the leſs water in the hanging arm; ſince that, to do that, it muſt at the ſame time weigh up over and above, as much more in the ciſtern as it ſelf weigheth.

But turning the argument; I ſay, that if once the arm of the ſyphon that is in the air, be ſuppoſed to draw any water, be it never ſo little, out of the ciſtern (whether occaſioned by ſucking or by whatſoever other means) it followeth that as much water as is drawn up, above the level of the whole bulk in the ciſtern, muſt needs preſs into the ſunken arm from the next adjacent parts, (that is, from the bottom) to ſupply its emptying; and as much muſt of it ſelf preſs dowm from above (according to its natural courſe, when nothing violenteth it) to reſt in the place, that the aſcending water (which is lower than it) leaveth at liberty for it to take poſſeſſion of. And then it cannot be doubted, but that, this deſcending water, having all its weight in preſſing down applied to drive up the riſing water in the ſunk arm of the ſyphon; & the water in the other arm of the ſyphon without, having all its weight in runing out applied at the ſame time to draw up the ſame water in the ſunk arm; this ſingle reſiſtant muſt yield to their double & maſtering force. And conſequently, the water in the arm of the ſyphon that is in the air, muſt needs draw the water that is in the other immerſed arm as long as the end of its pipe reacheth lower than the level of the water in the ciſtern; for ſo long

long it appeareth by what we have said, it must needs be more weighty; since part of the rising water in the sunk arm of the syphon, is counterpoised by as much descending water in the cistern

And thus it is evident, that out of this experiment it cannot be inferred that parts of water do not weigh within the orb of their own whole: but onely, that two equal parts of water in their own orb (namely that which riseth in the sunken arm, and that which presseth down from the whole bulk in the cistern) are of equal weight, and do ballance one another. So that never so little oddes between the two counterpoising parcels of water which are in the air must needs make the water run out at that end of the syphon, where the overweight of water is.

7. Concerning attraction caused by fire.

The attraction whose cause next to this is most manifest, is that which is made by the force of heat or of fire; for we see that fire ever draweth air unto it; so notably, that if in a close room there be a good fire, a man that standeth at the door or at the window (especially without) shall hear such a noise that he will think there is a great wind within the chamber. The reason of this attraction is, that fire rarifying the air which is next unto it; and withall spending it self perpetually, causeth the air, and his own body mingled together, to flie up through the chimney or by some other passage. Whence it followeth of necessity that the next body must succeed into the place of the body that is flown away. This next body generally is air, whose mobility and fluidity beyond all other bodies, maketh it of all others the fittest to be drawn; and the more of it that is drawn the more must needs follow. Now if there be floting in this air any other atoms subject to the current which the air taketh; they must also come with it to the fire, and by it, must be rarified, and be exported out of that little orb.

Hence it is, that men (with very good reason) do hold that fire aireth a chamber, as we term it, that is, purifieth it, both because it purifieth it as wind doth by drawing a current of air into it that sweepeth through it, or by making it purifie it self by motion, as a stream of water doth by running; as also, because those vapors which approach the fire, are burned and dissolved. So that the air being noisome and unwholesome by reason of its grossnes, proceeding from its standing unmoved (like a stagnation of dead water, in a marish place) the fire taketh away that cause of annoiance.

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By this very rule we learn that other hot things, which participate the nature of fire, must likewise (in other respects) have a resemblance in this quality. And accordingly we see that hot loafs in a bakers shop newly drawn out of the oven, are accounted to draw unto them any infection which is in the air. The like we say of onions, & other strong breathing substances; which by their smell shew much heat in them. In like manner it is conceived that pigeons, and rabets, and cats easily take infection, by reason of their extraordinary warmth which they have in themselves.

8. Concerning attraction made by virtue of hot bodies, amulets, &c.

And this is confirmed by the practise of Physicians, who use to lay warm pigeons newly killed to the feet, wrists, or heads of sick persons; & young puppies to their stomacks, & sometimes certain hot gums to their navels; to draw out such vapors or humors as infest the body: for the same reason they hang amulets of arsenick, sublimate, dried toads or spiders, about their patients necks, to draw unto them venimous qualities from their bodies. Hence also it is, that if a man be strucken by a viper or a scorpion, they use to break the body of the beast it self that stung him (if they can get it) upon the wound: but if that beast be crawled out of their finding, they do the like by some other venimous creature; as I have seen a bruised toad laid to the biting of a viper. And they manifestly perceive the applied body, to swell with the poyson sucked out from the wound, and the patient to be relieved and have less poyson; in the same manner as by cupping-glasses, the poyson is likewise drawn out from the wound: so that you may see, the reason of both, is the very same; or at the least very like one another. Onely, we are to note, that the proper body of the beast out of which the venom was driven into the wound, is more efficacious than any other to suck it out.

And the like is to be observed in all other kinds, that such vapors as are to be drawn, do come better and incorporate faster in bodies of like nature, than in those which have onely the common conditions of heat and driness; the one of which serveth to attract; the other to fasten and incorporate into it self the moisture which the first draweth unto it. So we see that water soketh into a dry body, whence it was extracted, almost inseparably, & is hidden in it; as when it raineth first after hot weather, the ground is presently dried after the showre. Likewise we see

that

that in most ciments, you must mingle a dust of the nature of the things w chare to be cimented, if you wil have them bind strongly.

9. The natural reason given for divers operations, esteemed by some to be magical.

Out of this discourse, we may yield a reason for those magical operation, which some attribute to the Devils assistance; peradventure because mans wickednes hath been more ingenious than his good will; and so hath found more means to hurt than to help; nay, when he hath arrived some way to help, those very helps have undergone the same calumny; because of the likenes which their operatio is have to the others. Without doubt very unjustly, if there be truth in the effects. For where have we any such good suggestions of the enemy of mankind proposed unto us, that we may with reason believe he would duly, settledly, and constantly concur to the help and service of all those he so much hateth, as he needs do if he be the Authour of such effects? Or is it not a wrong to Almighty God, and to his carefull instruments; rather to impute unto the Devil the aids which to some may seem supernatural, than unto them of whom we may justly believe and expect such good offices and assistances? I mean, those operations, both good and bad, which ordinarily are called *Magnetical*, though peradventure wrongfully, as not having that property which denominateth the loadstone.

One thing I may assure, that if the reports be true, they have the perfect imitation of nature in them. As for example; that the weapons salve, or the sympathetick powder doth require in the using it, to be conserved in an equal and moderate temper: and that the weapon which made the wound, or the cloth upon which the bloud remaineth that issued from it, be orderly and frequently dressed; or else the wounded person will not be cured: likewise the steam or spirits, which at the giving of the wound did enter into the pores of the weapon, must not be driven out of it, (which will be done by fire; and so when it is heated by holding over coals, you may see a moisture sweat out of the blade at the opposite side to the fire, as far as it entred into the wounded persons body; which being once all sweated out, you shall see no more the like steam upon the sword) neither must the bloud be washed out of the bloudy cloth; for in these cases, the powder, or salve, will work nothing. Likewise, if there be any excess either of heat or of cold in keeping the medicated wea[on or cloth, the patient feeleth that, as he would do, if the like

excess

excess were in any remedy that were applied to the wound it self: likewise if the medicated weapon or bloudy cloth, be kept too close, no effect followeth: likewise, the natures of the things used in these cures are of themselves sovereign for healing the like griefs, though peradventure too violent if they were applyed in body without much attenuation.

And truly if we will deny all effects of this kind, we must in a manner renounce all humane faith: men of all sorts and qualities (and many of them such in my own knowledge, as I cannot question their prudence in observing, or their sincerity in relating) having very frequently made experience of such medicines, and all affirming after one fashion to have found the same effects. Add to these, the multitude of other like effects, appearing or conceited to appear in other things. In some countries it is a familiar disease with kine to have a swelling in the soles of their feet: and the ordinary cure is, to cut a turf upon which they have troden with their sore foot, and to hang it upon a hedg; and as that drieth away, so will their sore amend. In other parts they observe, that if milk newly come from the cow, do in the boiling run over into the fire; and that this do happen often, and neer together to the same cows milk; that cow will have her udder sore and inflamed: and the prevention is to cast salt immediately into the fire upon the milk. The herb *Persicaria* if it be well rubbed upon warts, and then be laid in some fit place to putrifie, causeth the warts to wear away as it rotteth: some say the like of fresh beef. Many examples also there are of hurting living creatures by the like means; which I set not down for fear of doing more harm by the evil inclination of some persons into whose hands they may fall; than profit by their knowing them, unto whom I intend this work.

But to make these operations of nature not incredible; let us remember how we have determined that every body whatsoever doth yield some steam, or vent a kinde of vapour from it self; and consider, how they must needs do so most of all, that are hot and moist, as bloud and milk are, and as all wounds and sores generally are. We see that the foot of a hare or deer leaveth such an impression where the beast hath passed, as a dog can discern it a long time after: and a fox breatheth out so strong a vapor, that the hunters themselves can wind it a great way off,

and

and a good while after he is parted from the place. Now joyning this, to the experiences we have already allowed of, concerning the attraction of heat; we may conclude, that if any of theſe vapors do light upon a ſolid warm body, which hath the nature of a ſource unto them, they will naturally congregate and incorporate there; and if thoſe vapors be joyned with any medicative quality or body, they will apply that medicament better than any Chirurgeon can apply it. Then, if the ſteam of bloud and ſpirits, do carry with it from the weapon or cloth, the balſamick qualities of the ſalve or powder, and with them do ſettle upon the wound; what can follow but a bettering in it? Likewiſe, if the ſteam of the corruption that is upon the clod, do carry the drying quality of the wind which ſweepeth over it when it hangeth high in the air, unto the ſore part of the cows foot; why is it not poſſible that it ſhould dry the corruption there, as well as it drieth it upon the hedg? And if the ſteam of burned milk can hurt by carrying fire to the dug; why ſhould not ſalt caſt upon it, be a preſervative againſt it? Or rather, why ſhould not ſalt hinder the fire from being carried thither? Since the nature of ſalt, alwaies hindereth and ſuppreſſeth the activity of fire: as we ſee by experience when we throw ſalt into the fire below, to hinder the flaming of ſoot in the top of a chimney: which preſently ceaſeth, when new fire from beneath doth not continue it. And thus we might proceed in ſundry other effects, to declare the reaſon and the poſſibility of them; were we certain of the truth of them: therefore we remit this whole queſtion, to the authority of the teſtimonies.

CHAP. XIX.

Of three other motions belonging to particular bodies, Filtration, Reſtitution, and Electrical attraction.

1. What is Filtration; and how it is effected.

After theſe, let us caſt our eye upon another motion, very familiar among Alchymiſts; which they call Filtration. It is effected by putting one end of a tongue, or label of flannen, or of cotton, or of flax, into a veſſel of water, and letting the other end hang over the brim of it. And it will by little and little draw all the water out of that veſſel (ſo that the end which hangeth out be lower than the ſuperficies of the water) and will make it all come over into any lower veſſel you will reſerve it in.

The

The end of this operation is, when any water is mingled with groſs and muddy parts (not diſſolved in the water) to ſeparate the pure & light ones from the impure. By which we are taught, that the lighter parts of the water, are thoſe which moſt eaſily do catch. And if we will examine in particular, how it is likely this buſineſs paſſeth; we may conceive that the body or linguet by which the water aſcendeth, being a dry one, ſome lighter parts of the water, whoſe chance it is to be neer the climbing body of flax, do begin to ſtick faſt unto it: and then, they require nothing neer ſo great force, nor ſo much preſſing, to make them climb up along the flax, as they would do to make them mount in the pure air. As you may ſee, if you hold a ſtick in running water, ſhelving againſt the ſtream: the water will run up along the ſtick, much higher than it could be forced up in the open air without any ſupport, though the agent were much ſtronger than the current of the ſtream. And a ball will upon a rebound, run much higher upon a ſhelving board, than it would if nothing touched it. And I have been told, that if an egg-ſhell filled with dew be ſet at the foot of a hollow ſtick, the Sun will draw it to the top of the ſhelving ſtick, whereas without a prop, it will not ſtir it.

With much more reaſon then we may conceive, that water finding as it were little ſteps in the cotton to facilitate its journey upwards, muſt aſcend more eaſily than thoſe other things do; ſo as it once received any impulſe to drive it upwards: for the gravity both of that water which is upon the cotton, as alſo, of ſo many of the confining parts of water as can reach the cotton, is exceedingly allaied, either by ſticking unto the cotton, and ſo weighing in one bulk with that dry body; or elſe, by not tending down ſtraight to the center, but reſting as it were upon a ſteep plain (according to what we ſaid of the arm of a ſyphon that hangeth very ſloping out of the water, and therefore draweth not after it a leſs proportion of water in the other arm that is more in a direct line to the center:) by which means the water as ſoon as it beginneth to climb, cometh to ſtand in a kinde of cone; neither breaking from the water below, (its bulk being big enough to reach unto it) nor yet falling down unto it.

2. What cauſeth the water in filtration to aſcend.

But our chief labour muſt be, to find a cauſe that may make the water begin to aſcend: To which purpoſe, conſider how water

of

of its own nature, compresseth it self together, to exclude any other body lighter than it is. Now in respect of the whole mass of the water, those parts which stick to the cotton, are to be accounted much lighter than water; not, because in their own nature they are so; but for the circumstances which accompany them, and do give them a greater disposition to receive a motion upwards than much lighter bodies, whiles they are destitute of such helps. Wherefore as the bulk of water weighing and striving downwards; it followeth that if there were any air mingled with it, it would to possess a lesser place, drive out the air: so here in this case, the water that is at the foot of the ladder of cotton, ready to climb with a very small impulse, may be after some sort compared (in respect of the water) to air by reason of the lightness of it: and consequently is forced up by the compressing of the rest of the water round about it. Which no sooner getteth up, but other parts at the foot of the ladder do follow the first, and drive them still upwards along the tow; and new ones drive the second, and others the third, and so forth. So that with ease they climb up to the top of the filter, still driving one another forwards, as you may do a fine towel through a musket barrel: which though it be too limber to be thrust straight through; yet cramming still new parts into it at the length you will drive the first quite through.

And thus, when these parts of water are got up to the top of the vessel on which the filter hangeth, and over it on the other side by sticking still to the tow, and by their natural gravity, against which nothing presseth on this side the label; they fall down again by little and little, and by drops break again into water in the vessel set to receive them.

3. Why the filter will not drop unless the label hang lower than the water.

But now if you ask, why it will not drop unless the end of the label that hangeth, be lower than the water. I conceive it is because the water which is all along upon the flannen, is one continued body hanging together, as it were a thrid of wire; and is subject to like accidents as such a continued body is. Now suppose you lay a wire upon the edge of the basin, which the filter resteth upon; and so make that edge the center to ballance it upon; if the end that is outermost be heaviest, it will weigh down the other; otherwise, not. So fareth it with this thrid of water: if the end of it that hangeth out of the pot, that is to be

filtred

filtred be longer, and consequently heavier, than that which riseth; it must needs raise the other upwards, and fall it self downwards. Now the raising of the other, implieth lifting more water from the cistern, and the sliding of it self farther downwards, is the cause of its converting into drops. So that the water in the cistern serveth like the flax upon a distaff, and is spun into a thrid of water, still as it cometh to the flannen by the drawing it up, occasioned by the over-weight of the thrid on the other side of the center.

Which to express better by a similitude in a solid body: I remember I have oftentimes seen in a Mercers shop, a great heap of massie gold lace lie upon their stall; and a little way above it a round smooth pin of wood, over which they use to hale their lace when they wind it into bottoms. Now over this pin, I have put one end of the lace; and as long as it hung no lower than the board upon which the rest of the lace did lie it stirred not; for as the weight of the loose end carried it one way, so the weight of the other side where the whole was, drew it the other way, and in this manner kept it in equilibrity. But as soon as I drew on the hanging end to be heavier than the climbing side (for no more weigheth than is in the air, that which lieth upon the board, having another center) then it began to roul to the ground: and still drew up new parts of that which lay upon the board, until all was tumbled down upon the flore. In the same manner it hapneth to the water, in which, the thrid of it upon the filter is to be compared fitly unto that part of the lace which hung upon the pin; and the whole quantity in the cistern, is like the bulk of lace upon the shopboard; for as fast as the filter draweth it up, it is converted into a thrid like that which is already upon the filter: in like manner as the wheel converteth the flax into yarn, as fast as it draweth it out from the distaff.

4. Of the motion of Restitution: and why some bodies stand bent, others not.

Our next consideration will very aptly fall upon the motion of those things, which being bent, do leap with violence to their former figure: whereas others return but a little; and others do stand in that ply, wherein the bending of them hath set them. For finding the reason of which effects, our first reflection may be to note, that a superficies which is more long than broad, containeth a less floor than that whose sides are equal, or nearer being equal: and that of those surfaces whose lines and angles are

all equal, that which hath moſt ſides and angles, containeth ſtill the greater floor. Whence it is, that Mathematicians conclude a circle to be the moſt capacious of all figures: and what they ſay of lines in reſpect of a ſuperficies, the ſame with proportion they ſay of ſurfaces in reſpect of the body contained. And accordingly we ſee by conſequence, that in the making a bag of a long napkin, if the napkin be ſewed together long-wiſe, it holdeth a great deal leſs than if it be ſewed together broad-wiſe.

By this we ſee plainly, that if any body which is in a thick and ſhort figure, be forced into a thinner (which by becoming thinner, muſt likewiſe become either longer or broader; for what it loſeth one way, it muſt get another) then that ſuperficies muſt needs be ſtretched; which in our caſe, is a phyſical outſide, or material part of a ſolid body, not a Mathematical conſideration of an indiviſible Entity. We ſee alſo that this change of figure happeneth in the bending of all thoſe bodies, whereof we are now enquiring the reaſon why ſome of them reſtore themſelves to their original figure, and others ſtand as they are bent.

Then to begin with the latter ſort, we find that they are of a moiſt nature; as among metals, lead, and tin; and among other bodies, thoſe which we account ſoft. And we may determine, that this effect proceedeth, partly from the humidity of the body that ſtandeth bent; and partly from a dryneſs peculiar to it, that comprehendeth and fixeth the humidity of it. For by the firſt, they are rendred capable of being driven into any figure, which nature or art deſireth: and by the ſecond, they are preſerved from having their gravity put them out of what figure they have once received.

But becauſe theſe two conditions are common to all ſolid bodies, we may conclude, that if no other circumſtance concurred, the effect ariſing out of them would likewiſe be common to all ſuch: and therefore, where we finde it otherwiſe, we muſt ſeek farther for a cauſe of that tranſgreſſion. As for example, if you bend the bodies of young trees, or the branches of others, they will return to their due figure. It is true, they will ſometimes lean towards that way they have been bent: as may be ſeen even in great trees after violent tempeſts; and generally the heads of trees, and the ears of corn, and the grown hedgerows will all bend one way in ſome Countreys, where ſome one wind hath a main

main predominance, and reigneth most continually, as near the sea-shore upon the western coast of *England* (where the south-west wind bloweth constantly the greatest part of the year) may be observed: but this effect proceeding from a particular and extraordinary cause, concerneth not our matter in hand.

We are to examine the reason of the motion of Restitution, which we generally see in young trees, and branches of others, as we said before. In such, we see that the earthy part which maketh them stiff (or rather stark) aboundeth more in them, than in the others that stand as they are bent: at the least in proportion to their natures; but I conceive this is not the cause of the effect we enquire about; but that it is a subtil spirit which hath a great proportion of fire in it. For as in rarefaction, we found that fire, which was either within or without the body to be rarified, did cause the rarefaction, either by entring into it, or by working within it: so seeing here the question is, for a body to go out of a lesser superficies into a greater (which is the progress of rarefaction; and happeneth in the motion of restitution;) the work must needs be done by the force of heat. And because this effect proceedeth evidently, out of the nature of the thing in which it is wrought, and not from any outward cause, we may conclude it hath its origine from a heat that is within the thing it self, or else that was in it, and may be pressed to the outward parts of it, and would sink into it again.

As for example, when a young tree is bended; both every mans conceit is, and the nature of the thing maketh us believe, that the force which bringeth the tree back again to its figure, cometh from the inner side that is bent; which is compressed together, as being shrunk into a circular figure from a straight one: for when solid bodies that were plain on both sides, are bent so as on each side to make a portion of a circle, the convex superficies will be longer than it was before, when it was plain, but the concave will be shorter. And therefore we may conceive, that the spirits which are in the contracted part, (being there squeezed into less room than their nature well brooketh) do work themselves into a greater space; or else that the spirits which are crusted out of the convex side by the extension of it, but do remain besieging it, and do strive to get in again, (in such manner as we have declared when we spoke of attraction, wherein we shewed

how the emitted ſpirits of any body will move to their own ſource, and ſettle again in it, if they be within a convenient compaſs;) and accordingly do bring back the extended parts to their former ſituation; or rather, that both theſe cauſes do in their kinds concur to drive the tree into its natural figure.

5. Why ſome bodies return onely in part to their natural figure; others entirely.

But as we ſee when a ſtick is broken, it is very hard to replace all the ſplinters, every one in its proper ſituation; ſo it muſt of neceſſity fall out in this bending, that certain inſenſible parts both inward and outward, are thereby diſplaced, and can hardly be perfectly rejoynted. Whence it followeth, that as you ſee the ſplinters of a half-broken ſtick, meeting with one another, do hold the ſtick ſomewhat crooked; ſo theſe inviſible parts do the like in ſuch bodies, as after bending ſtand a little that way. But becauſe they are very little ones, the tree or the branch that hath been never ſo much bended, may (ſo nothing be broken in it) be ſet ſtraight again by pains, without any notable detriment of its ſtrength. And thus you ſee the reaſon of ſome bodies returning in part to their natural figure, after the force leaveth them, that did bend them.

Out of which you may proceed to thoſe bodies that reſtore themſelves entirely: whereof ſteel is the moſt eminent. And of it, we know that there is a fiery ſpirit in it, which may be extracted out of it, not onely by the long operations of calcining, digeſting and diſtilling it; but even by groſs heating it, and then extinguiſhing it in wine and other convenient liquors, as Phyſicians uſe to do. Which is alſo confirmed by the burning of ſteel-duſt in the flame of a candle, before it hath been thus wrought upon, which afterwards it will not do: whereby we are taught that originally there are ſtore of ſpirits in ſteel, till they are ſucked out. Being thus aſſured, that in ſteel there is ſuch abundance of ſpirits; and knowing that it is the nature of ſpirits to give a quick motion; and ſeeing that duller ſpirits in trees do make this motion of Reſtitution; we need ſeek no farther, what it is that doth it in ſteel, or in any other things that have the like nature: which through the multitude of ſpirits that abound in them (eſpecially ſteel) do return back with ſo ſtrong a jerk, that their whole body will tremble a great while after, by the force of its own motion.

6. Concerning the nature of

By what is ſaid, the nature of thoſe bodies which do ſhrink and ſtretch, may eaſily be underſtood: for they are generally compoſed

posed of stringy parts, unto which, if humidity happen to arrive, they grow thereby thicker and shorter. As we see that drops of water getting into a new rope of a well, or into a new cable, will swell it much thicker, and by consequence make it shorter. *Galileus* noteth such wetting to be of so great efficacy, that it will shrink a new cable, and shorten it notably; notwithstanding the violence of a tempest, and the weight and jerks of a loden ship, do strain it what is possible for them to stretch it. Of this nature leather seemeth to be, and parchment, and divers other things, which if they be proportionably moistened, (and no exteriour force be applyed to extend them) will shrink up; but if they be overwetted, they will become fluxeid. Again, if they be suddenly dried, they will shrivel up; but if they be fairly dried after moderate wetting, they will extend themselves again to their first length. those bodies which do shrink and stretch.

7. How great and wonderfull effects proceed from small, plain, and simple principles.

The way having been opened by what we have discoursed before we came to the motion of Restitution, towards the discovery of the manner how heavy bodies may be forced upwards contrary to their natural motion, by very small means in outward appearance; let us now examine (upon the same grounds) if like motions to this of water, may not be done in some other bodies in a subtiler manner. In which, more or less needeth not trouble us; since we know, that neither quantity nor the operations of it do consist in an indivisible, or are limited to determined periods they may not pass. It is enough for us to find a ground for the possibility of the operation: and then the perfecting of it and the reducing of it to such a height as at the first might seem impossible and incredible, we may leave to the oeconomy of wise nature. He that learneth to reade, write, or to play on the lute, is in the beginning ready to lose heart at every step; when he considereth with what labour, difficulty, and slowness he joyneth the letters, spelleth syllables, formeth characters, fitteth and breaketh his fingers (as though they were upon the rack) to stop the right frets, and to touch the right strings. And yet you see how strange a dexterity is gained in all these by industry and practice, and a readiness beyond what we could imagine possible, if we saw not daily the effects.

If then we can but arrive to decipher the first characters of the hidden alphabet we are now taing in hand, and can but spel-

lingly read the first syllables of it; we need not doubt, but that the wise Authour of nature in the masterpiece of the creature (which was to express the excellency of the workman) would with excellent cunning and art dispose all circumstances so aptly, as to speak readily a complete language rising from those Elements; and that should have as large an extent in practise and expression, beyond those first principles, which we like children onely lisp out; as the vast discourses of wisest and most learned men are beyond the spellings of infants: and yet those discourses spring soom the same root, as the others spellings do, and are but a raising of them to a greater height; as the admired musick of the best player of a lute or harp, that ever was, is derived from the harsh twangs of coarse bowstrings, which are composed together and refined, till at length they arrive to that wonderfull perfection. And so without scruple, we may in the business we are next falling upon, conclude, that the admirable and almost miraculous effects we see, are but the elevating to a wonderfull height those very actions and motions which we shall produce as causes and principles of them.

8. Concerning Electrical attraction.

Let us then suppose, that there is a solid hard body, of an unctuous nature; whose parts are so subtile and fiery, that with a little agitation they are much rarified, and do breath out in steams, (though they be too subtile for our eyes to discern) like unto the steame that issueth from sweating men or horses, or like the steam that flyeth from a candle when it is put out: but that these steams, as soon as they come into the cold air, are by that cold suddenly condensed again; and by being condensed, do shorten themselves, and by little and little do retire, till they settle themselves upon the body from whence they sprung: in such manner as you may observe, the little tender horns of snails use to shrink back if any thing touch them, till they settle in little lumps upon their heads. If I say these strings of bituminous vapor should in their way outwards meet with any light and spungie body, they would pierce into it, and settle in it; and if it were of a competent bigness for them to wield, they would carry it with them which way soever they go; so that if they shrink back again to the fountain from whence they came, they must needs carry back with them the light spungie body they have fixed their darts in.

Consider then, that how much heat rarifieth, so much cold condenseth:

condenſeth: and therefore ſuch parts as by agitation were ſpun out into a ſubtile thrid of an inch long for example, as they cool, do grow bigger and bigger, and conſequently ſhorter and ſhorter, till at length, they gather themſelves back into their main body; and there they ſettle again in cold bitumen as they were at the firſt; and the light body that they ſtick unto, is drawn back with them, and conſequently ſticketh to the ſuperficies of the bitumen. As if ſomething were tyed at one end of a luteſtring extended to its utmoſt capacity, and the other end were faſtened to ſome pin; as the ſtring ſhrinketh up, ſo that which is tyed at it, muſt needs move nearer and nearer the pin: which artifice of nature jugglers do imitate, when by means of an unſeen hair, they draw light bodies to them. Now if all this operation be done, without your ſeeing the little thrids which cauſe it; the matter appears wonderfull and ſtrange. But when you conſider this progreſs that we have ſet down, you will judge it poſſible.

And this ſeemeth to be the caſe of thoſe bodies which we call Electrical; as yellow amber, jet, and the like. All which, are of a bituminous unctuous nature, as appeareth by their eaſie combuſtibility and ſmel, when they are burned. And if ſome do not ſo apparently ſhew this unctuous nature, it is becauſe either they are too hard, or elſe they have a high degree of aqueous humidity joyned with their unctuoſity: and in them the operation will be duller in that proportion; for as we ſee that unctuous ſubſtances are more odoriferous than others, and do ſend their ſteams farther off, and more efficaciouſly; ſo we cannot doubt but that ſuch bodies as conſiſt in a moiſt nature do accordingly ſend forth their emanations in a feebler proportion. Yet that proportion will not be ſo feeble, but that they may have an Electrical effect, as well as the more efficacious Electrial bodies, which may be perceptible, if exact experience be made by an inſtrument like the mariners needle; as our learned country-man D. *Gilbert* teacheth.

But that in thoſe eminent agents, the ſpirits, whereby they attract, are unctuous, is plain, becauſe the fire conſumeth them; and ſo if the agents be overheated they cannot work; but moderate heat even of fire increaſeth their operation. Again, they are clogged by miſty air, or by wetting: and likewiſe, are pierced through and cut a ſunder by ſpirit of wine or *aquæ ardentes*; but oyl doth not hurt them. Likewiſe, they yield more ſpirits in

the sun than in the shade; and they continue longer, when the air is cleared by North or by Eastern winds. They require to be polished, either because the rubbing which polisheth them, doth take off from their surfaces the former emanations, which returning back do stick upon them, and so do hinder the passage of those that are within; or else, because their outsides may be foul; or lastly, because the pores may be dilated by that smoothing. Now that hardness and solidity is required, doth argue that these spirits must be quick ones, that they may return smartly, and not be lost through their languishing in the air. Likewise, that all bodies which are not either exceeding rare, or else set one fire, may be drawn by these unctuous thrids; concludeth that the quality by which they do it, is a common one that hath no particular contrarieties; such a one as we see is in grease or in pitch to stick to any thing; from which in like manner nothing is exempted but fire and air. And lastly, that they work most efficaciously, when they are heated by rubbing, rather than by fire; sheweth that their spirits are excitated by motion, and are thereby made to fly abroad; in such manner as we see in pomanders, and in other perfumes, which must be heated if you will have them communicate their sent: and alike effect as in them, agitation doth in jets, yellow amber, and such other Electrical bodies; for if upon rubbing them, you put them presently to your nose, you will discern a strong bituminous smell in them all; which circumstances do shew that this electrical virtue, consists in a certain degree of rarity or density of the bodies unctuous emanations.

Now if these refined and viscous thrids of jet or amber, do in their streaming abroad meet with a piece of straw, or of hay, or of a dryed leaf, or some such light and spungie body; it is no marvail if they glew themselves unto it like birdlime; and that in their shrinking back (by being condensed again and repulsed, through the coldness of the air) they carry it along with them to their entire body. Which they that onely see the effect, and cannot penetrate into a possibility of a natural cause thereof, are much troubled withall.

9. *Cabeus* his opinion refuted concerning the cause of Electrical motions

And this seemeth unto me to bear a fairer semblance of truth, than what *Cabeus* delivereth for the cause of Electrical attractions. Whose speculation herein, though I cannot allow for solid, yet I must for ingenious. And certainly even errors are to be commended,

commended, when they are witty ones, and do proceed from a caſting farther about than the beaten track of verbal learning, or rather terms which explicate not the nature of the thing in queſtion. He ſaith, that the coming of ſtraws and ſuch other light bodies unto amber, jet, and the like, proceedeth from a wind raiſed by the forcible breaking out of ſubtile emanations from the Electrical bodies into the air, which bringeth thoſe light bodies along with it to the Electrial ones.

But this diſcourſe cannot hold: for firſt, it is not the nature of unctuous emanations (generally ſpeaking) to cauſe ſmart motions ſingly of themſelves. Secondly, although they ſhould raiſe a wind, I do not comprehend how this wind ſhould drive bodies directly back to the ſource that raiſed it; but rather any other way; and ſo conſequently, ſhould drive the light bodies it meeteth with in its way, rather from, than towards the Electrical body. Thirdly, if there ſhould be ſuch a wind raiſed, and it ſhould bring light bodies to the Electrical ones; yet it could not make them ſtick thereunto, which we ſee they do, turn them which way you will, as though they were glewed together.

Neither do his experiences convince any thing; for what he ſaith that the light bodies are ſometimes brought to the Electrical body with ſuch a violence, that they rebound back from it, and then return again to it, maketh rather againſt him: for if wind were the cauſe of their motion, they would not return again, after they had leaped back from the Electrical body; no more than we can imagine that the wind it ſelf doth.

The like is of his other experience, when he obſerved that ſome little grains of ſaw-duſt hanging at an Electrical body, the farthermoſt of them not onely fell off, but ſeemed to be driven away forcibly: for they did not fall directly down, but ſideways; and beſides did fly away with a violence and ſmartneſs that argued ſome ſtrong impulſe. The reaſon whereof might be that new emanations might ſmite them, which not ſticking and faſtening upon them, whereby to draw them nearer, muſt needs puſh them farther: or it might be that the emanations unto which they were glewed, ſhrinking back unto their main body, the later grains were ſhouldered off by others that already beſieged the ſuperficies; & then the emanations retiring ſwiftly the grains muſt break off with a force: or elſe we may conceive it was the force

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of the air that bore them up a little, which made an appearance of their being driven away; as we see feathers and other light things descend not straight down.

CHAP. XX.

Of the Loadstones generation, and its particular motions.

1. The extreme heat of the sun under the zodiack, draweth a stream of air from each pole into the torrid zone.

THere is yet remaining, the great mystery of the Loadstone to discourse of. Which all Authors, both antient and modern, have agreed upon as an undenyable example and evidence of the shortness of mans reach in comprehending, and of the impossibility of his reason in penetrating into, and explicating such secrets, as nature hath a mind to hide from us. Wherefore our reader (I am sure) will not in this subject expect clear satisfaction or plain demonstrations, at our hands: but will judge we have fairly acquitted our selves, if what we say be any whit plausible.

Therefore, to use our best indeavours to content him; let us reflect upon the dispostion of parts of this habitable globe whereof we are tenants for lives; And we shall find that the sun by his constant course under the zodiack, heateth a great part of it unmeasurably more than he doth the rest. And consequently, that this zodiack being in the middest between two (as it were) ends, which we call the Poles, these poles must necessarily be extremely cold, in respect of the torrid zone; for so we call that part of the earth which lieth under the zodiack.

Now looking into the consequence of this; we find that the sun, or the suns heat which reflecteth from the earth in the torrid zone, must rarifie the air extremely, and according to the nature of all heat and fire, must needs carry away from thence, many parts of the air and of the earth sticking to that heat, in such sort as we have formerly declared.

Whence it followeth, that other air must necessarily come from the regions towards both the poles, to suply what is carried away from the middle, as is the course in other fires, and as we have explicated above: especially considering, that the air which cometh from the polewards, is heavier than the air of the torrid zone; and therefore, must naturally press to be still nearer the earth; and so, as it were shouldereth up the air

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of

of the torrid zone towards the circumference, by rolling into its place: and this, in great quantityes; and consequently, the polar air must draw a great train after it.

Which if we consider the great extent of the torrid zone, we shall easily perswade our selves, that it must reach on each side, to the very poles; for taking from *Archimedes*, that the spherical superficies of a portion of a sphere, is to the superficies of the whole sphere, according as the parts of the axis of that sphere comprised within the said portion, is to the whole axis: and considering that (in our case) the part of the axis comprised within the torrid zone, is to the whole axis of the earth, in about the proportion of 4. to 10; it must of necessity follow, that a fire or great heat reigning in so vast an extent, will draw air very powerfully from the rest of the world.

Neither let any man apprehend that this course of the suns elevating so great quantities of atoms in the torrid zone, should hinder the course of gravity there: for first the medium is much rarer in the torrid zone than in the other parts of the earth; and therefore the force of the descending atoms needeth not to be so great there as in other places, to make bodies descend there as fast as they do elsewhere. Secondly, there being a perpetual supply of fresh air from the polar parts, streaming continually into the torrid zone; it must of necessity happen that in the air there come atoms to the torrid zone, of that grossness, that they cannot suddenly be so much rarified as the subtiler parts of air that are there: and therefore, the more those subtiler parts are rarified, and thereby happen to be carried up, the stronger and the thicker the heavier atoms must descend. And thus this concurse of air from the polar parts, maintaineth gravity under the zodiack; where otherwise all would be turned into fire, and so have no gravity.

Now, who considereth the two hemispheres which by the equator are divided; will find that they are not altogether of equal complexions; but that our hemisphere, in which the North-pole is comprised, is much dryer than the other, by reason of the greater continent of land in this, and the vaster tract of sea in the other; and therefore the supply which cometh from the divers hemispheres, must needs be of different natures; that which cometh from towards the Southpole, being compared to

2. The atoms of these two streams coming together are apt to incorporate with one another.

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that which cometh from towards the north, as the more wet to the more dry. Yet of how different complexions soever they be, you see they are the emanations of one and the same body. Not unlike unto what nature hath instituted in the rank of animals: among whom, the male and the female are so distinguished by heat and cold, moisture and drought, that nevertheless all belongeth but to one nature; and that, in degrees though manifestly different, yet so near together, that the body of one is in a manner the same thing, as the body of the other. Even so, the complexions of the two hemispheres are in such sort different in the same qualities, that nevertheless they are of the same nature, and are unequal parts of the same body which we call the earth. Now Alchymists assure us, that if two extractions of one body do meet together, they will incorporate one with the other; especially, if there be some little difference in the complexion of the extractions.

3. By the meeting and mingling together of these streams at the Equator, divers rivolets of atoms of each pole, are continuated from one pole to the other.

Whence it followeth, that these two streams of air, making up one continuat flood of various currents, from one end of the world to the other; each stream that cometh to the equator from its own Pole, by the extraction of the sun, and that is still supplyed with new matter flowing from its own pole to the equator, before the sun can sufficiently rarifie and lift up the atoms that came first perpendicularly under its beams (as it useth to happen in the effects of physical causes, which cannot be rigorously ajusted, but must have some latitude; in which, nature inclineth ever rather to abundance than to defect,) will pass, even to the other pole, by the conduct of his fellow, in case he be by some occasion driven back homewards.

For as we see in a boule or paile full of water, or rather in a pipe, through which the water runneth along; if there be a little hole at the bottom or side of it, the water will wriggle and change its course to creep out at that pipe; especially if there be a little spiggot, or quill at the outside of the hole, that by the narrow length of it helpeth in some sort (as it were) to suck it. So if any of the files of the army or flood of atoms sucked from one of the poles to the equator, do there find any gappes, or chinks, or lanes of retiring files in the front of the other poles battalia of atoms, they will press in there: in such manner as we have above declared that water doth by the help of a label

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of cotton; and as is exemplified in all the attractions of venom by venomous bodies, whereof we have given many examples above: and they will go along with them the courſe they go. For as when a thick ſhort gilded ingot of ſilver is drawn out into a long ſubtil wyre; the wyre continuing ſtill perfectly gilded all over, doth manifeſtly ſhew that the outſide and the inſide of the ingot, do ſtrangely meet together, and intermix in the drawing out: ſo this little ſtream which (like an eddy current) runneth back from the equator towards its own Pole, will continue to the end ſtill tincted with the mixture of the other Poles atoms, it was incorporated with at his coming to the equator.

Now that ſome little rivolets of air and atoms ſhould run back to their own Pole, contrary to the courſe of their main ſtream, will be eaſily enough to conceive, if we but conſider that at certain times of the year winds do blow more violently and ſtrongly from ſome determinate part or Romb of the world, than they do at other times, and from other parts. As for example; our *Eaſt-India* Mariners tell us of the famous Monſones they finde in thoſe parts; which are ſtrong winds that reign conſtantly ſix moneths of the year from one polewards, and the other ſix moneths, from the other pole, and begin preciſely about the ſuns entring into ſuch a ſign or degree of the zodiack, and continue till about its entrance into the oppoſite degree. And in our parts of the world, certain ſmart Eaſterly or North-eaſterly winds do reign about the end of March and beginning of April; when it ſeemeth that ſome ſnows are melted by the ſpring-heats of the ſun. And other winds have their courſes in other ſeaſons, upon other cauſes. All which do evidently convince, that the courſe of the air, and of vapours from the poles to the equator, cannot be ſo regular and uniform, but that many impediments and croſſes do light in the way, to make breaches in it; and thereby to force in it ſome places to an oppoſite courſe. In ſuch ſort as we ſee happeneth in eddy waters, and in the courſe of a tide, wherein the ſtream running ſwiftly in the middle, beateth the edges of the water to the ſhore, and thereby maketh it run back at the ſhore. And hence we may conclude, That although the main courſe of air and atoms (for example, from north to ſouth, in our hemiſphere) can never fail of going on towards the equator, conſtantly at the

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same rate in grosse; nevertheless, in several particular little parts of it (and especially at the edges of those streams that are driven on faster than the rest, by an extraordinary and accidental violent cause) it is variously interrupted, and sometimes entirely stopped, and other times even driven back to the northwards.

And if peradventure any man should think that this will not fall out, because each stream seemeth to be alwaies coming from his own Pole to the equator, and therefore will oppose and drive back any bodies that with less force should strive to swim against it; or if they stick unto them, will carry them back to the equator. We answer, that we must not conceive that the whole air in body doth every where equally incroch from the polewards upon the torrid zone; but, as it were, in certain brooks or rivolets, according as the contingency of all causes put together doth make it fall out.

Now then out of what we have said, it will follow, That since all the air in this our hemisphere, is as it were strewed over and sowed with abundance of northern atoms, and that some brooks of them are in station, others in a motion of retrogradation back to their own north pole; the southern atoms (which coming upon them at the equator, do not onely press in among them, whersoever they can finde admittance, but do also go on forwards to the north pole in several files by themselves, being driven that way by the same accidental causes, which make the others retire back) seizing in their way upon the northern ones in such manner as we described in filtration; and thereby creeping along by them whersoever they finde them standing still, and going along with them whersoever they finde them going back; must of necessity finde passage in great quantities towards, and even to the north pole; though some parts of them will ever and anon be checked in this their journey by the main current prevailing over some accidental one, and so be carried back again to the equator, whose line they had crossed.

And this effect cannot choose but be more or less, according to the seasons of the year: for when the sun is in the Tropick of Capricorn, the southern atoms will flow in much more abundance, and with far greater speed, into the torrid zone, than the northern atoms can; by reason of the suns approximation to the south, and his distance from the north pole; since he work-

worketh faintest, when he is farthest off: and therefore from the north no more emanations or atoms will be drawn, but such as are most subtilised, and duly prepared for that course. And since onely these selected bands do now march towards the equator, their files must needs be thinner, than when the suns being in the equator or Tropick of Cancer, wakeneth and mustereth up all their forces. And consequently, the quiet parts of air between their files (in which like atoms are also scattered) are the greater: whereby the advenient southern atoms have the larger filter to climb up by. And the like happeneth in the other hemisphere, when the sun is in the Tropick of Cancer; as who will bestow the pains to compare them, will presently see.

4. Of these atoms incorporated with some fit matter in the bowels of the earth, is made a stone.

Now then let us consider what these two streams thus incorporated, must of necessity do in the surface or upper parts of the earth. First, it is evident they must needs penetrate a pretty depth into the earth; for so freezing perswadeth us, and much more, the subtil penetration of divers more spiritual bodies, of which we have sufficiently discoursed above. Now let us conceive that these streams do find a body of convenient density to incorporate themselves in, in the way of density, as we see that fire doth in iron, and in other dense bodies: and this not for an hour or two, as happeneth in fire, but for years; as I have been told, that in the extreme cold hills in the Peak in Darbyshire happeneth to the dry atoms of cold, which are permanently incorporated in water by long continual freezing, and so make a kinde of chrystal.

In this case, certainly it must come to pass, that this body will become in a manner wholly of the nature of these steams: which because they are drawn from the Poles that abound in cold and dryness, (for others that have not these qualities, do not contribute to the intended effect) the body is apteſt to become a stone: for so we see that cold & drought turneth the superficial parts of the earth into stones & rocks; & accordingly, whersoever cold & dry winds reign powerfully, all such countreys are mainly rocky.

5. This stone worketh by emanations, joyned with agreeing

Now then, let us suppose this stone to be taken out of the earth, and hanged in the air, or set conveniently upon some little pin, or otherwise put in liberty, so as a small impulse may easily turn it any way: it will in this case certainly follow, that the

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streams that meet them in the air; and in fire it is a load-stone.

end of the stone, which in the earth lay towards the north pole, will now in the air convert it self in the same manner towards the same point; and the other end which lay towards the south, turn by consequence to the south. I speak of these countreys which lie between the equator and the north; in which it cannot choose but that the stream going from the north to the equator, must be stronger than the opposite one.

Now to explicate how this is done; suppose the stone hanged east and west freely in the air; the stream which is drawn from the north pole of the earth rangeth along by it in its course to the equator; and finding in the stone the south steam, (which is grown innate to it) very strong, it must needs incorporate it self with it; and most, by those parts of the steam in the stone which are strongest: which are they that come directly from the North of the stone; by which I mean that part of the stone that lay northward in the earth, and that still looketh to the north pole of the earth now it is in the air. And therefore the great flood of atoms coming from the north pole of the earth, will incorporate it self most strongly, by the north end of the stone with the little flood of southern atoms it findeth in the stone: for that end serveth for the coming out of the southern atoms, and sendeth them abroad; as the south end doth the northern steam, since the steams do come in at one end, and do go out at the opposite end.

From hence we may gather, that this stone will joyn and cleave to its attractive, whensoever it happeneth to be within the sphere of its activity. Besides, if by some accident it should happen that the atoms or steams which are drawn by the sun from the Polewards to the equator, should come stronger from some part of the earth, which is on the side-hand of the Pole, than from the very Pole it self; in this case the stone will turn from the Pole towards that side. Lastly, whatsoever this stone will do towards the Pole of the earth; the very same a lesser stone of the same kind will do towards a greater. And if there be any kind of other substance that hath participation of the nature of this stone, such a substance will behave it self towards this stone, in the same manner, as such a stone behaveth it self towards the earth: all the Phenomens whereof may be the more plainly observed, if the stone be cut into the form of the earth.

And

And thus, we have found a perfect delineation of the loadstone from its causes: for there is no man so ignorant of the nature of a loadstone, but he knoweth that the properties of it are to tend towards the North; to vary sometimes; to joyn with another loadstone; to draw iron unto it; and such like; whose causes you see delivered.

6. A method for making experiences upon any subject.

But to come to experimental proofs and observations upon the loadstone, by which it will appear, that these causes are well esteemed and applyed, we must be beholding to that admirable searcher of the nature of the loadstone, Doctour *Gilbert*; by means of whom and of Doctour *Harvey*, our nation may claim even in this latter age, as deserved a crown for solid Philosophical learning, as for many ages together it hath done formerly for acute and subtile speculations in Divinity. But before I fall to particulars, I think it worth warning my Reader, how this great man arrived to discover so much of Magnetical philosophy; that he likewise, if he be desirous to search into nature, may by imitation advance his thoughts and knowledge that way.

In short then, all the knowledge he got of this subject, was by forming a little loadstone into the shape of the earth. By which means he compassed a wonderfull designe, which was, to make the whole globe of the earth maniable: for he found the properties of the whole earth, in that little body; which he therefore called a Terrella, or little earth; and which he could manage and try experiences upon, at his will. And in like manner, any man that hath an aim to advance much in natural sciences, must endeavor to draw the matter he inquireth of, into some small model, or into some kind of manageable method; which he may turn and wind as he pleaseth. And then let him be sure, if he hath a competent understanding, that he will not miss of his mark.

7. The loadstones generation by atoms flowing from both poles, is confirmed by experiments observed in the stone it self.

But to our intent; the first thing we are to prove is, that the loadstone is generated in such sort as we have described: for proof whereof, the first ground we will lay shall be to consider how in divers other effects it is manifest, that the differences of being exposed to the north or to the south, do cause very great variety in the same thing: as hereafter, we shall have occasion to touch, in the barks and grains of trees, and the like. Next, we find by experience, that this virtue of the loadstone is received into

into other bodies that reſemble its nature, by heatings and coolings: for ſo it paſſeth in iron bars, which being throughly heated, and then laid to cool north and ſouth, are thereby imbued with a *Magnetick* virtue; heat opening their bodies, and diſpoſing them to ſuck in ſuch atoms as are convenient to their nature, that flow unto them whiles they are cooling. So that we cannot doubt, but that convenient matter fermenting in its warm bed under the earth, becommeth a loadſtone by the like ſucking in of affluent ſtreams of a like complexion to the formrr.

And it fareth in like manner with thoſe fiery inſtruments (as fire-forks, tongues, ſhovels, and the like) which do ſtand conſtantly upwards and downwards; for they, by being often heated and cooled again, do gain a very ſtrong verticity, or turning to the pole: and indeed, they cannot ſtand upwards and downwards ſo little a while, but that they will in that ſhort ſpace gain a manifeſt verticity; and change it at every turning. Now ſince the force and vigour of this verticity, is in the end that ſtandeth downwards; it is evident that this effect proceedeth out of an influence received from the earth.

And becauſe in a loadſtone (made into a globe, or conſidered ſo, to the end you may reckon hemiſpheres in it, as in the great earth) either hemiſphere giveth unto a needle touched upon it, not onely the virtue of that hemiſphere, where it is touched, but likewiſe the virtue of the contrary himiſphere; we may boldly conclude, that the virtue which a loadſtone is impregnated with in the womb or bed of the earth, where it is formed and groweth, proceedeth as well from the contrary hemiſphere of the earth, as from that wherin it lyeth; in ſuch ſort, as we have above deſcribed. And as we feel oftentimes in our own bodies, that ſome cold we catch remaineth in us a long while after the taking it, and that ſometimes it ſeemeth even to change the nature of ſome part of our body into which it is chiefly entered, and hath taken particular poſſeſſion of; ſo that whenſoever new atoms of the like nature, do again range about in the circumſtant air, that part ſo deeply affected with the former ones of kin to theſe, doth in a particular manner ſeem to reſſent them, and to attract them to it, and to have its gueſts within it (as it were) wakened and rouſed up by the ſtrokes of the advenient ones that knock at their doors. Even ſo (but much more

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strongly, by reason of the longer time and less hinderances) we may conceive that the two virtues or atoms proceeding from the two different hemispheres, do constitute a certain permanent and constant nature in the stone that imbibeth them: which then, we call a loadstone; and is exceeding sensible (as we shall hereafter declare) of the advenience to it of new atoms, alike in nature and complexion to those that it is impregnated with.

And this virtue, consisting in a kind of softer and tenderer substance than the rest of the stone, becometh thereby subject to be consumed by fire. From whence we may gather the reason why a loadstone never recovereth its magnetick virtue, after it hath once lost it; though iron doth; for the humidity of iron is inseparable from its substance, but the humidity of a loadstone, wch maketh it capable of this effect, may be quite consumed by fire; and so the stone may be left too dry, for ever being capable of imbibing any new influence from the earth, unless it be by a kind of new making it.

8. Experiments to prove that the loadstone worketh by emanations meeting with agreeing streams.

In the next place we are to prove that the loadstone doth work in that manner as we have shewed; for which end let us consider how the atoms that are drawn from each pole and hemisphere of the earth to the equator, making up their course by a manuduction of one another, the hindermost cannot choose but still follow on after the foremost. And as it happineth in filtration by a cotten cloth; if some one part of the cotten, have its disposition to the ascent of the water, more perfect and ready than the other parts have; the water will assuredly ascend faster in that part, than in any of the rest: so, if the atoms do find a greater disposition for their passage, in any one part of the medium they range through, than in any other, they wil certainly not fail of taking that way, in greater abundance, and with more vigour and strength, than any other.

But it is evident, that when they meet with such a stone as we have described, the helps by which they advance in their journey are notably encreased by the flood of atoms which they meet coming out of that stone; which being of the nature of their opposite pole, they seise greedily upon them, and thereby do pluck themselves faster on: like a ferryman that draweth on his boat the swiftlier, the more vigorously he tugeth and pulleth at the rope that lyeth thwart the river for him to hale himself

over by. And therefore we cannot doubt but that this flood of atoms streaming from the pole of the earth, must needs pass through that stone with more speed and vigour than they can do any other way.

And as we see in the running of water; that if it meeteth with any lower cranies than the wide channel it streameth in; it will turn out of its straight way, to glide along there where it findeth an easier and more declive bed to tumble in: so these atoms will infallibly deturn themselves from their direct course, to pass through such a stone as far as their greater conveniency leadeth them.

And what we have said of these atoms, which from the poles do range through the vast sea of air to the equator; is likewise to be applied unto those atoms which issue out of the stone: so that we may conclude, that if they meet with any help which may convey them on with more speed and vigour, than whiles they stream directly forwards, they will likewise deturn themselves from directly forwards, to take that course. And if the stone it self be hanged so nicely, that a less force is able to turn it about than is requisite to turn awry out of its course the continued stream of atoms which issueth from the stone: in this case, the stone it self must needs turn towards that stream which climbing and filtring it self along the stones stream, draweth it out of its course; in such sort as the nose of a weathercock butteth it self into the wind. Now then, it being known, that the strongest stream cometh directly from the north in the great earth, and that the southern stream of the Terrella or loadstone proportioned duely by nature to incorporate with the north stream of the earth, issueth out of the north end of the stone; it follows plainly, that when a loadstone is situated at liberty, its north end must necessarily turn towards the north pole of the world.

And it will likewise follow, that whensoever such a stone meeteth with another of the same nature and kind, they must comport themselves to one another in like sort: that is, if both of them be free and equal, they must turn themselves to, or from one another; according as they are situated in respect of one another. So that if their axes be parallel, and the south pole of the one, and the north of the other do look the same way, then they will send proportionate, and agreeing streams to one another

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from their whole bodies, that will readily mingle and incorporate with one another, without turning out of their way, or seeking any shorter course, or changing their respects to one another.

But if the poles of the same denomination do look the same way, and the loadstones do not lie in such sort as to have their axes parallel, but that they encline to one another: then they will work themselves about, until they grow by their opposite poles into a straight line; for the same reason as we have shewed of a loadstones turning to the pole of the earth.

But if onely one of the loadstones be free, & the other be fixed, and that they lie inclined, as in the former case; then, the free stone will work himself until his pole be opposite to that part of the fixed stone from whence the stream wch agrees with him, issueth strongest: for that stream is to the free loadstone, as the northern stream of the earth, is to a loadstone compared unto the earth. But withal, we must take notice that in this our discourse, we abstract from other accidents; & particularly, frō the influence of the earths streams into the loadstones: wch will cause great variety in these cases, if they lie not due north & south, when they begin to work.

And as loadstones and other magnetick bodies, do thus of necessity turn to one another when they are both free; and if one of them be fastened, the other turneth to it; so likewise, if they be free to progressive motion, they must by a like necessity, and for the same reason, come together and joyn themselves to one another. And if onely one of them be free, that must remove it self to the other: for the same virtue that maketh them turn, (which is, the strength of the stream) will likewise (in due circumstances) make them come together; by reason that the steams which climb up one another by the way of filtration, and do thereby turn the bodies of the stones upon their centers when they are onely free to turn, must likewise draw the whole bodies of the stones entirely out of their places, & make them joyn, when such a total motion of the body is an effect that requireth no more force, than the force of conveying vigorously the streams of both the magnetick bodies into one another; that is, when there is no such impediment standing in the way of the magnetick bodies motion, but that the celerity of the atoms motion, mingling with one another, is able to overcome it: for then, it must needs do so; and the magnetick body by natural coherence unto the steam

of atoms in which it is involved, followeth the course of the steam: in such sort as the example we have heretofore upon another occasion given of an egg-shell filled with dew, the sunbeams converting the dew into smoke, and raising up that smoke or steam, the egg-shell is likewise raised up for company with the steam that issueth from it.

And for the same reason it is, that the loadstone draweth iron: for iron being of a nature apt to receive and harbour the steams of a loadstone; it becometh a weak loadstone, and worketh towards a loadstone, in such sort as a weaker loadstone would do: and so moveth towards a loadstone by the means we have now described. And that this conformity between iron and the loadstone is the true reason of the loadstones drawing of iron, is clear out of this, that a loadstone will take up a greater weight of pure iron, than it will of impure or drossie iron; or of iron and some other metal joyned together: and that it will draw farther through a slender long iron, than in the free open air: all which are manifest signs, that iron cooperateth with the force which the loadstone graffeth in it. And the reason why iron cometh to a loadstone more efficaciously than another loadstone doth, is, because loadstones generally are more impure than iron is (as being a kind of ore or mine of iron) and have other extraneous and heterogeneal natures mixed with them: whereas iron receiveth the loadstones operation in its whole substance.

CHAP. XXI.

Positions drawn out of the former Doctrine, and confirmed by experimental proofs.

1. The operations of the loadstone are wrought by bodies, and not by qualities.

THe first Position is, That the working of the loadstone, being throughout according to the tenor of the operation of bodies, may be done by bodies, and consequently is not done by occult or secret qualities. Which is evident out of this, that a greater loadstone hath more efficacy than a lesser: and that if you cut away part of a loadstone, part of his vertue is likewise taken from him: and if the parts be joyned again, the whole becometh as strong as it was before.

Again, if a loadstone touch a longer iron, it giveth it less force than if it touch a shorter iron: nay, the vertue in any part is

is sensibly lesser, according as it is farther from the touched part.

Again, the longer an iron it in touching, the greater vertue it getteth, and the more constant. And both an iron and a loadstone may lose their vertue, by long lying out of their due order and situation, either to the earth, or to another loadstone.

Besides, if a loadstone do touch a long iron in the middle of it, he diffuseth his vertue equally towards both ends; and if it be a round plate, he diffuseth his vertue equally to all sides.

And lastly, the vertue of a loadstone, as also of an iron touched, is lost by burning it in the fire. All which symptoms agreeing exactly with the rules of bodies, do make it undeniable, that the vertue of the loadstone is a real and solid body.

2. Objections against the former position answered.

Against this Position, *Cabeus* objecteth, that little atoms would not be able to penetrate all sorts of bodies; as we see the vertue of the loadstone doth. And urgeth, that although they should be allowed to do so, yet they could not be imagined to penetrate thick and solid bodies so suddenly, as they would do thin ones; and would certainly shew then some sign of facility or difficulty of passing, in the interposition, and in the taking away of bodies put between the loadstone and the body it works upon. Secondly, he objecteth, That atoms being little bodies, they cannot move in an instant; as the working of the loadstone seemeth to do. And lastly, That the loadstone by such abundance of continual evaporations, would quickly be consumed.

To the first we answer, That atoms whose nature it is to pierce iron, cannot reasonably be suspected of inability to penetrate any other body: and that atoms can penetrate iron, is evident in the melting of it by fire. And indeed this objection cometh now too late, after we have so largely declared the divisibility of quantity, and the subtilty of nature in reducing all things into extreme small parts: for this difficulty hath no other avow, than the tardity of our imaginations in subtilizing sufficiently the quantitative parts that issue out of the loadstone.

As for any tardity that may be expected by the interposition of a thick or dense body; there is no appearance of such, since we see light pass through thick glasses without giving any sign of meeting with the least opposition in its passage, (as we have above declared at large:) and magnetical emanations have the advantage of light in this, that they are not obliged to straight lines, as light is.

Lastly, as for loadstones spending of themselves by still venting their emanations; odoriferous bodies furnish us with a full answer to that objection: for they do continue many years palpably spending of themselves, and yet keep their odour in vigour; whereas a loadstone, if it be laid in a wrong position, will not continue half so long. The reason of the duration of both which, maketh the matter manifest, and taketh away all difficulty: which is, that as in a root of a vegetable, there is a power to change the advenient juyce into its nature; so is there in such like things as these, a power to change the ambient air into their own substance, as evident experience sheweth in the Hermetike salt, (as some modern Writers call it) which is found to be repaired, and increased in its weight by lying in the air; and the like happeneth to salt-peter. And in our present subject experience informeth us, that a loadstone will grow stronger by lying in due position, either to the earth, or to a stronger loadstone, whereby it may be better impregnated, and as it were feed it self with the emanations issuing out of them into it.

3. The loadstone is imbued with his virtue from another body.

Our next position is, That this virtue cometh to a magnetick body, from another body; as the nature of bodies is, to require a being moved, that they may move. And this is evident in iron, which by the touch, or by standing in due position near the loadstone, gaineth the power of the loadstone. Again, if a smith in beating his iron into a rod, do observe to lay it north & south; it getteth a direction to the north by the very beating of it. Likewise if an iron rod be made red hot in the fire, and be kept there a good while together, and when it is taken out be laid to cool just north and south, it will acquire the same direction towards the north. And this is true not onely of iron, but also of all other sorts of bodies whatsoever, that indure such ignition: particularly of pot earths, which if they be moulded in a long form, and when they are taken out of the kiln be laid (as we said of the iron) to cool north and south, will have the same effect wrought in them. And iron, though it hath not been heated, but only hath continued long unmoved in the same situation of north and south in a building; yet it will have the same effect. So as it cannot be denied, but that this virtue cometh unto iron from other bodies; whereof one must be a secret influence from the north. And this is confirmed, by a loadstones losing its virtue (as we

we ſaid before) by lying a long time unduly diſpoſed, either towards the earth, or towards a ſtronger loadſtone; whereby in ſtead of the former, it gaineth a new virtue according to that ſituation.

And this happeneth, not onely in the virtue which is reſident and permanent in a loadſtone, or a touched iron; but likewiſe in the actual motion or operation of them. As may be experienced, firſt in this, that the ſame loadſtone or touched iron in the ſouth hemiſphere of the world, hath its operation ſtrongeſt at that end of it which tendeth to the north; and in the north hemiſphere at the end which tendeth to the ſouth: each pole communicateth a vigour proportionable to its own ſtrength in the climate where it is received. Secondly in this, that an iron joyned to a loadſtone, or within the ſphere of the loadſtones working, will take up another piece of iron greater than the loadſtone of it ſelf can hold; and as ſoon as the holding iron is removed out of the ſphere of the loadſtones activity, it preſently letteth fall the iron it formerly held up: and this is ſo true, that a leſſer loadſtone may be placed in ſuch ſort within the ſphere of a greater loadſtones operation, as to take away a piece of iron from the greater loadſtone; and this in virtue of the ſame greater loadſtone from which it plucketh it: for, but remove the leſſer out of the ſphere of the greater, and then it can no longer do it. So that it is evident, that in theſe caſes the very actual operation of the leſſer loadſtone or of the iron, proceedeth from the actual influence of the greater loadſtone upon and into them. And hence we may underſtand, that whenſoever a magnetick body doth work, it hath an excitation from without, which doth make it iſſue out and ſend its ſtreams abroad; in ſuch ſort as it is the nature of all bodies to do; and as we have given examples of the like done by heat, when we diſcourſed of Rarefaction.

But to explicate this point more clearly, by entring more particularly into it; if a magnetick body lieth north and ſouth, it is eaſie & obvious to conceive that the ſtreams coming from north and ſouth of the world, and paſſing through the ſtone, muſt needs excitate the virtue which is in it, and carry a ſtream of it along with them that way they go. But if it lieth eaſt and weſt, then the ſtreams of north and ſouth of the earth, ſtreaming along by the two poles of the ſtone, are ſucked in by them much more weakly:

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yet nevertheless sufficiently to give an excitation to the innate steams which are in the body of the stone, to make them move on in their ordinary course.

4. The virtue of the loadstone is a double, and not one simple virtue.

The third Position is, That the virtue of the loadstone is a double and not one simple vertue. Which is manifest in an iron touched by a loadstone; for if you touch it onely with one pole of the stone, it will not be so strong and full of the magnetick virtue, as if you touch one end of it with one pole, and the other end of it with the other pole of the stone. Again, if you touch both ends of an iron, with the same pole of the stone, the iron gaineth its virtue at that end which was last touched; and changeth its virtue from end to end, as often as it is rubbed at contrary ends. Again, one end of the loadstone or of iron touched, will have more force on the one side of the equator, and the other end on the other side of it. Again, the variation on the one side of the equator, and the variation on the other side of it, have different laws, according to the different ends of the loadstone, or of the needle, which looketh to those poles.

Wherefore it is evident, that there is a double virtue in the loadstone, the one more powerfull at the one end of it; the other more powerfull at the other end. Yet these two virtues are found in every sensible part of the stone: for cutting it at either end, the virtue at the contrary end is also diminished. And the whole loadstone that is left, hath both the same virtues, in proportion to its bigness. Besides, cut the loadstone how you will, still the two poles remain in that line, which lay under the meridian when it was in the earth. And the like is of the touched iron, whose virtue still lieth along the line, which goeth straight (according to the line of the axis) from the point where it was touched, and at the opposite end, constituteth the contrary pole.

5. The virtue of the loadstone worketh more strongly in the poles of it, than in any other part.

The fourth Position is, That though the virtue of the loadstone be in the whole body; nevertheless, its virtue is more seen in the poles, than in any other parts. For by experience it is found, that a loadstone of equal bulk, worketh better and more efficaciously if it be in a long form, than if it be in any other. And from the middle line betwixt the two poles, there cometh no virtue, if an iron be touched there: but any part towards the pole, the nearer it is to the pole, the greater party it imparteth. Lastly, the declination teacheth us the same; which is so much the stronger by how much it is nearer the pole.

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The fifth Position is, That in the loadstone there are emanations which do issue not onely at the poles and about them, but also spherically, round about the whole body, and in an orb from all parts of the superficies of it; in such sort as happeneth in all other bodies whatsoever. And that these spherical emanations are of two kinds; proportionable to the two polar emanations. And that the greatest force of each sort of them is in that hemisphere where the pole is, at which they make their chief issue.

6. The loadstone sendeth forth its emanations spherically. Which are of two kinds: and each kind is strongest in that hemisphere, through whose polary parts they issue out.

The reason of the first part of this position is, because no particular body can be exempt from the laws of all bodies: and we have above declared, That every physical body must of necessity have an orb of fluours, or a sphere of activity about it. The reason of the second part is, that seeing these fluours do proceed out of the very substance and nature of the loadstone, they cannot choose but be found of both sorts, in every part how little soever it be, where the nature of the loadstone resideth. The reason of the third part is, that because the polar emanations do tend wholly towards the poles (each of them to their proper pole) it followeth, that in every hemisphere, both those which come from the contrary hemisphere, and those which are bred in the hemisphere they go out at, are all assembled in that hemisphere: and therefore of necessity it must be stronger in that kind of fluours, than the opposite end is. All which appeareth true in experience: for if a long iron toucheth any part of that hemisphere of a loadstone which tendeth to the north, it gaineth at that end a virtue of tending likewise to the north: and the same will be if an iron but hang close over it. And this may be confirmed by a like experience, of an iron bar in respect of the earth which hanging downwards in any part of our hemisphere, is imbued with the like inclination of drawing towards the north.

7. Putting two loadstones within the sphere of one another, every part of one loadstone doth not agree with every part of the other loadstone.

The sixth Position is, That although every part of one loadstone do *in it self* agree with every part of another loadstone, (that is, if each of these parts were divided from their wholes, and each of them made a whole by it self, they might be so joyned together as they would agree;) nevertheless, when the parts are in their two wholes, they do not all of them agree together: but of two loadstones, onely the poles of the one do agree with the whole body of the other; that is, each pole with any part of the contrary hemisphere of the other loadstone.

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The reason of this is, because the fluours which issue out of the stones, are in certain different degrees in several parts of the entire loadstones; whereby it happeneth that one loadstone can work by a determinate part of it self most powerfully upon the other, if some determinate part of that other do lie next unto it; and not so well, if any other part lieth towards it. And accordingly experience sheweth, that if you put the pole of a loadstone towards the middle of a needle that is touched at the point, the middle part of the needle will turn away, and the end of it will convert it self to the pole of the loadstone.

8. Concerning the declination and other respects of a needle, towards the loadstone it toucheth.

The seventh Position is, That if a touched needle and a loadstone do come together, and touch one another in their agreeing parts (whatsoever parts of them those be) the line of the needles length will bend towards the pole of the stone (excepting, if they touch by the equator of the stone, and the middle of the needle:) yet not so, that if you draw out the line of the needles length, it will go through the pole of the stone; unless they touch by the end of the one, and the pole of the other. But if they touch by the equator of the one, and the middle of the other, then the needle will lie parallel to the axis of the stone.

And the reason of this is manifest, for in that case the two poles being equidistant to the needle, they draw it equally; and by consequence the needle must remain parallel to the axis of the stone. Nor doth it import, that the inequality of the two poles of the stone is materially or quantitatively greater than the inequality of the two poles of the needle; out of which it may at the first sight seem to follow, that the stronger pole of the stone should draw the weaker pole of the needle nearer unto it self, than the weaker pole of the stone can be able to draw the stronger pole of the needle: and by consequence, that the needle should not lie parallel to the axis of the stone, but should incline somewhat to the stronger pole of it. For after you have well considered the matter, you will finde that the strength of the pole of the stone, cannot work according to its material greatness, but is confined to work onely according to the susceptibility of the needle: the which, being a slender and thin body, cannot receive so much as a thicker body may. Wherefore, seeing that the strongest pole of the stone giveth most strength to that pole of the needle, which lieth fartheſt from it; it may well happen that

that this superiority of strength in the pole of the needle that is applied to the weaker pole of the stone, may counterpoise the excess of the stronger pole of the stone, over its opposite weaker pole; though not in greatness and quantity, yet in respect of the virtue which is communicable to the poles of the needle; whereby its comportment to the poles of the stone is determined. And indeed the needles lying parallel to the axis of the stone when the middle of it sticketh to the equator of the stone, convinceth that upon the whole matter, there is no excess in the efficacious working of either of the stones poles: but that their excess over one another in regard of themselves is ballanced by the needles receiving it.

But if the needle hapneth to touch the loadstone in some part nearer one pole than the other; in this case it is manifest that the force of the stone is greater on the one side of the needles touch, than on the other side; because there is a greater quantity of the stone on the one side of the needle than on the other: and by consequence the needle will incline that way which the greater force draweth it; so far forth as the other part doth not hinder it. Now we know, that if the greater part were divided from the rest, and so were an intire loadstone by it self (that is, if the loadstone were cut off where the needle toucheth it) then the needle would joyn it self to the pole, that is to the end of that part: and by consequence, would be tending to it, in such sort as a thing that is sucked tendeth towards the sucker, against the motion or force which cometh from the lesser part: and on the other side the lesser part of the stone which is on the other side of the point which the needle toucheth, must hinder this inclination of the needle according to the proportion of its strength; and so it followeth, that the needle will hang by its end, not directly set to the end of the greater part, but as much inclining towards it as the lesser part doth not hinder by stryving to pull it the other way. Out of which we gather the true cause of the needles declination, to wit the proportion of working of the two unequal parts of the stone, between which it toucheth and is joyned to the stone.

9. The virtue of the loadstone goeth from end

And we likewise discover their errour who judge that the part which draweth iron is the next Pole unto the iron. For it is rather the contrary pole which attracteth; or to speak more pro-

to end in lines almost parallel to the axis.

properly it is the whole body of the stone as streaming in lines almost parallel to the axis, from the farthermost end, to the other end which is nexr to the iron: and (in our case) it is that part of the stone which beginneth from the contrary pole and reacheth to the needle. For besides the light which this discourse gave us, experience assureth us that a loadstone, whose poles lie broadwayes, not long-wayes, the stone is more imperfect, and draweth more weakly than if the poles lay long-wayes; which would not be if the fluours did stream from all parts of the stone directly to the pole: for then, howsoever the stone were cast, the whole virtue of it would be in the poles. Moreover, if a needle were drawn freely upon the same meridian from one pole to the other as soon as it were passed the equator, it would leap suddenly at the very first remove of the equator, where it is parrallel with the axis of the load-stone, from being so parallel, to make an angle with the axis greater than a half right one, to the end that it might look upon the pole which is supposed to be the onely attractive that draweth the needle: which great change wrought all at once, nature never causeth nor admitteth, but in all actions or motions, useth to pass through all the mediums whensoever it goeth from one extreme to another. Besides, there would be no variation of the needles aspect towards the north end of the stone: for if every part did send its virtue immediately to the poles, it were impossible that any other part whatsoever should be stronger than the polar part, seeing that the polar part had the virtue even of that particular part, and of all the other pats of the stone besides, joyned in it self.

This therefore is evident, that the virtue of the loadstone goeth from end to end in parallel lines; unless it be in such stones as have their polar parts narrower than the rest of the body of the stone: for in them, the stream will tend with some little declination towards the pole, as it were by way of refraction; because without the stone, the fluours from the pole of the earth do coarct themselves, and do so thicken their stream, to croud into the stone as soon as they are sensible of any emanations from it, that being (as we have said before) their readiest way to pass along: and within the stone, the stream doth the like to meet the advenient stream where it is strongest and thickest; which is, at that narrow part of the stones end, which is most prominent out.

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And by this discourse we discover likewise another errour of them that imagine the loadstone hath a sphere of activity round about it, equal on all sides; that is, perfectly spherical, if the stone be spherical. Which clearly is a mistaken speculation: for nature having so ordered all her agents, that where the strength is greatest, there the action must (generally speaking) extend it self farthest off; and it being acknowledged that the loadstone hath greatest strength in its poles, and least in the equator; it must of necessity follow, that it worketh farther by its poles, than by its equator. And consequently it is impossible that its sphere of activity should be perfectly spherical.

10. The virtue of the loadstone is not perfectly spherical, though the stone be such.

Nor doth *Cabeus* his experience move us to conceive the loadstone hath a greater strength to retain an iron laid upon it by its equator, than by its poles: for to justifie his assertion, he should have tried it in an iron wire that were so short as the poles could not have any notable operation upon the ends of it; since otherwise, the force of retaining it will be attributed to the poles (according to what we have above delivered) and not to the equator.

The eigth position is, that the intention of nature in all the operations of the loadstone, is to make an union betwixt the attractive and the attracted bodies. Which is evident out of the sticking of them together: as also out of the violence wherewith iron cometh to a loadstone; which when it is drawn by a powerfull one, is so great, that through the force of the blow hitting the stone, it will rebound back again, and then fall again to the stone: and in like manner a needle upon a pin, if a loadstone be set near it, turneth with so great a force towards the pole of the stone, that it goeth beyond it, and coming back again, the celerity wherewith it moveth maketh it retire it self too far on the other side; and so by may undulations, at the last it cometh to rest directly opposite to the pole. Likewise, by the declination; by means of which, the iron to the stone, or the stone to the earth, approcheth in such a disposition as is most convenient to joyn the due ends together, And lastly, out of the flying away of the contrary ends from one another: which clearly is to no other purpose, but that the due ends may come together. And in general, there is no doubt but ones going to another, is instituted by the order of nature for their coming together, and for their being together, which is but a perseverance of their coming together

11. The intention of nature in all the operations of the loadstone, is to make an union betwixt the attractive and attracted bodies.

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12. The main globe of the earth is not a loadstone.

The ninth position is, that the nature of a loadstone doth not sink deeply into the main body of the earth, as to have the substance of its whole body be magnetical, but onely remaineth near the surface of it. And this is evident by the inequality in virtue of the two ends; for if this magnetick virtue were the nature of the whole body, both ends would be equally strong. Nor would the disposition of one of the ends be different from the disposition of the other. Again, there could be no variation of the tending towards the north: for the bulk of the whole body would have a strength so eminently greater than the prominences and disparities of hils or seas, as the varieties of these would be absolutely insensible. Again, if the motion of the loadstone came from the body of the earth, it would be perpetually from the center, and not from the poles; and so, there could be no declination more in one part of the earth, than in another. Nor would the loadstone tend from north to south, but from the center to the circumference; or rather from the circumference to the center.

And so we may learn the difference between the loadstone and the earth in their attractive operations; to wit, that the earth doth not receive its influence from another body, nor doth its magnetick virtue depend of another magnetike agent, that impresseth it into it: which nevertheless, is the most remarkable condition of a loadstone. Again, the strongest virtue of the loadstone, is from pole to pole: but the strongest virtue of the earth, is from the center upwards, as appeareth by fire-forks gaining a much greater magnetike strength in a short time, than a loadstone in a longer. Neither can it be thence objected, that the loadstone should therefore receive the earths influences more strongly from the centerwards, than from the poles of the earth, (which by its operation, and what we have discoursed of it, it is certain it doth not;) since the beds where loadstones lie and are formed be towards the bottom of that part or back of the earth which is imbued with magnetike virtue. Again, this virtue which we see in a loadstone, is substantial to it; whereas the like virtue is but accidental to the earth, by means of the suns drawing the northern and southern exhalations to the equator.

13. The loadstone is generated in all parts or climats of the earth.

The last position is, that the loadstone must be found over all the earth, and in every country. And so we see it is: both because iron mines are found (in som measure) almost in all countries: & because,

cause, at the least other sorts of earth (as we have declared of potearths) cannot be wanting in any large extent of country; which when they are baked and cooled in due positions, have this effect of the loadstone, and are of the nature of it. And Doctour *Gilbert* sheweth, that the loadstone is nothing else but the ore of steel or of perfectest iron; and that it is to be found of all colours, and fashions, and almost of all consistences.

So that we may easily conceive, that the emanations of the loadstone being every where, as well as the causes of gravity; the two motions of magnetik things and of weighty things, do both of them derive their origine from the same source; I mean, from the very same emanations comming from the earth; which by a divers ordination of nature, do make this effect in the loadstone, and that other in weighty things. And who knoweth but that a like sucking to this which we have shewed in magnetick things, passeth also in the motion of gravity? In a word; gravity beareth a fair testimony in the behalf of the magnetick force; and the loadstones working returneth no mean verdict for the causes of gravity, according to what we have delivered of them.

14. The conformity betwixt the two motions of magnetick things and of heavy things.

CHAP. XXII.

A solution of certain problemes concerning the loadstone, and a short sum of the whole doctrine touching it.

OUt of what is said upon this subject, we may proceed to the solution of certain questions or problemes, which are or may be made in this matter. And first of that which Doctor *Gilbert* disputeth against all former writers of the loadstone; to wit, which is the North, and which the South pole of a stone? Which seemeth unto me, to be onely a question of the name: for if by the name of north and south, we understand that end of the stone which hath that virtue that the north or south pole of the earth have, then it is certain, that the end of the stone which looketh to the south pole of the earth, is to be called the north pole of the loadstone; and contrariwise, that which looketh to the north, is to be called the south pole of it. But if by the names of north and south pole of the stone, you mean those ends of it, that lie and point to the north and to the south

1. Which is the North, and which the South pole of a loadstone.

poles of the earth; then you must reckon their poles contrariwise to the former account. So that the terms being once defined, there will remain no farther controversie about the point.

2. Whether any bodies besides magnetick ones be attractive.

Doctour *Gilbert* seemeth also to have another controversie with all writers; to wit, whether any bodies besides magnetical ones be attractive? Which he seemeth to deny; all others to affirm. But this also being fairly put, will peradventure prove no controversie: for the question is either in common, of attraction; or else in particular, of such an attraction as is made by the loadstone. Of the first part, there can be no doubt; as we have declared above; and as is manifest betwixt gold and quicksilver, when a man holding gold in his mouth, it draweth unto it the quicksilver that is in this body. But for the attractive to draw a body unto it self, not wholly, but one determinate part of the body drawn, unto one determinate part of the drawer; is an attraction which for my part I cannot exemplifie in any other bodies but magnetical ones.

3. Whether an iron placed perpendicularly towards the earth, doth get a magnetical virtue of pointing towards the north, or towards the south, in that end that lieth downwards.

A third question is, whether an iron that standeth along time unmoved in a window, or any other part of a building, perpendicularly to the earth, doth contract a magnetical virtue of drawing or pointing towards the north in that end which looketh downwards. For *Cabeus* (who wrote since *Gilbert*) affirmeth it out of experience: but either his experiment or his expression was defective. For assuredly if the iron standeth so, in the northern hemisphere, it will turn to the north; and if in the southern hemisphere, it will turn to the south: for seeing the virtue of the loadstone proceedeth from the earth, and that the earth hath different tempers towards the north, and towards the south pole (as hath been already declared) the virtue which cometh out of the earth in the northern hemisphere, will give unto the end of the iron next it an inclination to the north pole; and the earth of the southern hemisphere will yield the contrary disposition unto the end which is nearest it.

4. Why loadstones affect iron better than one another.

The next question is, why a loadstone seemeth to love iron better than it doth another loadstone? The answer is, because iron is indifferent in all its parts to receive the impression of a loadstone; whereas another loadstone receiveth it onely in a determinate part: and therefore a loadstone draweth iron more easily than it can another loadstone; because it findeth repugnance

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in the parts of another loadstone, unless it be exactly situated in a right position. Besides, iron seemeth to be compared to a loadstone, like as a more humid body to a dryer of the same nature; and the difference of male and female sexes in animals do manifestly shew the great appetence of conjunction between moisture and dryness, when they belong to bodies of the same species.

Another question is that great one; why a loadstone capped with steel, takes up more iron than it would do if it were without that capping? Another conclusion like unto this, is, that if by a loadstone you take up an iron, and by that iron a second iron, and then you pull away the second iron; the first iron (in some position) will leave the loadstone to stick unto the second iron, as long as the second iron is within the sphere of the loadstones activity; but if you remove the second out of that sphere, then the first iron remaining within it, though the other be out of it, will leave the second, and leap back to the loadstone. To the same purpose, is this other conclusion, That the greater the iron is, which is intirely within thr compass of the loadstones virtue, the more strongly the loadstone will be moved unto it, and the more forcibly it will stick to it.

5. *Gilbert*'s reason refuted touching a capped loadstone, that taketh up more iron than one not capped; and an iron impregnated that in some case, draweth more strongly than the stone it self.

The reasons of all these three, we must give at once; for they hang all upon one string. And in my conceit neither *Gilbert* nor *Galileo* have hit upon the right. As for *Gilbert*, he thinketh that in iron there is originally the virtue of the loadstone; but that it is as it were asleep until by the touch of the loadstone it be awaked and set on work: and therefore the virtue of both joyned together, is greater than the virtue of the loadstone alone.

But if this were the reason, the virtue of the iron would be greater in every regard, and not onely in sticking or in taking up: whereas himself confesseth, that a capped stone draweth no farther than a naked stone, nor hardly so far. Besides, it would continue its virtue out of the sphere of activity of the loadstone, which it doth not. Again, seeing that if you compare them severally, the virtue of the loadstone is greater than the virtue of the iron; why should not the middle iron stick closer to the stone than to the farther iron which must of necessity have less virtue?

6. *Galileo* yieldeth the cause of this effect, that when an iron

Galileus his opinion touching the former effects refuted.

toucheth an iron there are more parts which touch one another, than when a loadstone toucheth the iron: both because the loadstone hath generally much impurity in it, and therefore divers parts of it have no virtue; whereas iron, by being melted hath all its parts pure: and secondly, beause iron can be smoothed and polished more than a loadstone can be: and therefore its superficies toucheth in a manner with all its parts; whereas divers parts of the stones superficies cannot touch, by reason of its ruggedness.

And he confirmeth his opinion by experience: for if you put the head of a needle to a bare stone, and the point of it to an iron; and then pluck away the iron; the needle will leave the iron and stick to the stone: but if you turn the needle the other way, it will leave the stone and stick to the iron. Out of which he inferreth that it is the multitude of parts, which causeth the close and strong sticking. And it seemeth he found the same in the capping of his loadstones: for he used flat irons for that purpose; which by their whole plain did take up other irons: whereas *Gilbert* capped his with convex irons; which not applying themselves to other iron, so strongly or with so many parts as *Galileo*'s did, would not by much take up so great weights as his.

Nevertheless, it seemeth not to me that his answer is sufficient, or that his reasons convince; for we are to consider that the virtue which he putteth in the iron, must (according to his own supposition) proceed from the loadstone: and then what importeth it, whether the superficies of the iron which toucheth another iron, be so exactly plain or no? Or that the parts of it be more solid than the parts of the stone? For all this conduceth nothing to make the virtue greater than it was: since no more virtue can go from one iron to the other, than goeth from the loadstone to the first iron: and if this virtue cannot tie the first iron to the loadstone, it cannot proceed out of this virtue that the second iron be tied to the first. Again, if a paper be put betwixt the cap and another iron, it doth not hinder the magnetical virtue from passing through it to the iron; but the virtue of taking up more weight than the naked stone was able to do, is thereby rendered quite useless. Therefore it is evident, that this virtue must be put in something else, and not in the application of the magnetical virtue.

And

And to examine his reasons particularly, it may very well fall out that whatsoever the cause be, the point of a needle may be too little to make an exact experience in; & therefore a new doctrine ought not lightly be grounded upon what appeareth in the application of that. And likewise, the greatness of the surfaces of the two irons may be a condition helpfull to the cause whatsoever it be: for greater and lesser are the common conditions of all bodies, and therefore do avail all kinds of corporeal causes; so that no one cause can be affirmed more than another, meerly out of this, that great doth more, and little doth less.

7. The Authors solution to the former questions.

To come then to our own solution: I have considered how fire hath in a manner the same effect in iron, as the virtue of the loadstone hath by means of the cap: for I finde that fire coming through iron red glowing hot, will burn more strongly, than if it should come immediately through the air; as also we see that in pitcoal the fire is stronger than in charcole. And nevertheless, the fire will heat farther if it come immediately from the source of it, than if it come through a red iron that burneth more violently where it toucheth; and likewise charcole will heat farther than pitcoal, that neer hand burneth more fiercely. In the same manner, the loadstone will draw farther without a cap than with one; but with a cap it sticketh faster than without one. Whence I see that it is not purely the virtue of the loadstone; but the virtue of it being in iron, which causeth this effect.

Now this modification may proceed either from the multitude of parts which come out of the loadstone, and are as it were stopped in the iron; and so the sphear of their activity becometh shorter, but stronger: or else from some quality of the iron joyned to the influence of the loadstone. The first seemeth not to give a good account of the effect; for why should a little paper take it away, seeing we are sure that it stoppeth not the passage of the loadstones influence? Again, the influence of the loadstone seemeth in its motion to be of the nature of light, which goeth in an insensible time as far as it can reach: and therefore were it multiplied in the iron, it would reach farther than without it; and from it the virtue of the loadstone would begin a new sphere of activity. Therefore we more willingly cleave to the latter part of our determination.

And thereupon enquiring what quality there is in iron, whence this effect may follow; we finde that it is diſtinguiſhed from a loadſtone, as a metal is from a ſtone. Now we know that metals have generally more humidity than ſtones; and we have diſcourſed above, that humidity is the cauſe of ſticking: eſpecially when it is little and denſe. Theſe qualities muſt needs be in the humidity of iron: which of all metals is the moſt terreſtrial: and ſuch humidity as is able to ſtick to the influence of the loadſtone, as it paſſeth through the body of the iron, muſt be exceeding ſubtil and ſmall; and it ſeemeth neceſſary that ſuch humidity ſhould ſtick to the influence of the loadſtone, when it meeteth with it, conſidering that the influence is of it ſelf dry, and that the nature of iron is a kin to the loadſtone: wherefore the humidity of the one, and the drought of the other will not fail of incorporating together. Now then, if two irons well poliſhed and plain, be united by ſuch a glew as reſulteth out of this compoſition, there is a manifeſt appearance of much reaſon for them to ſtick ſtrongly together. This is confirmed by the nature of iron in very cold countreys and very cold weather: for the very humidity of the air in times of froſt, will make upon iron, ſooner than upon other things, ſuch a ſticking glew as will pull off the skin of a mans hand that toucheth it hard.

And by this diſcourſe, you will perceive that *Galileo*'s arguments do confirm our opinion as well as his own; and that according to our doctrine, all circumſtances muſt fall out juſt as they do in his experiences. And the reaſon is clear why the interpoſition of another body hindereth the ſtrong ſticking of iron to the cap of the loadſtone; for it maketh the mediation between them greater, which we have ſhewed to be the general reaſon why things are eaſily parted.

Let us then proceed to the reſolution of the other caſes propoſed. The ſecond is already reſolved: for if this glew be made of the influence of the loadſtone, it cannot have force farther than the loadſtone it ſelf hath: and ſo far it muſt have more force than the bare influence of the loadſtone. Or rather the humidity of two irons maketh the glew of a fitter temper to hold, than that which is between a dry loadſtone and iron; and the glew entereth better when both ſides are moiſt, than when onely one is ſo.

But

But this resolution though it be in part good, yet it doth not evacuate the whole difficulty, since the same case happeneth between a stronger and a weaker loadstone, as between a loadstone and iron: for the weaker loadstone, whilest it is within the sphear of activity of the greater loadstone, draweth away an iron set betwixt them, as well as a second iron doth. For the reason therefore of the little loadstones drawing away the iron, we may consider that the greater loadstone hath two effects upon the iron, which is betwixt it and a lesser loadstone, and a third effect upon the little loadstone it self. The first is that it impregnateth the iron, and giveth it a permanent vertue by which it worketh like a weak loadstone. The second is, that as it maketh the iron work towards the lesser loadstone by its permanent vertue; so also it accompanieth the steam that goeth from the iron towards the little loadstone with its own steam, which goeth the same way: so that both these steams do in company climb up the steam of the little loadstone which meeteth them; and that steam climbeth up the inlarged one of both theirs together. The third effect which the greater loadstone worketh, is that it maketh the steam of the little loadstone become stronger by augmenting its innate vertue in some degree.

8. The reason why in the former case, a lesser loadstone doth draw the interjacent iron from the greater.

Now then, the going of the iron to either of the loadstones must follow the greater and quicker conjunction of the two meeting steams, and not the greatness of one alone. So that if the conjunction of the two steams between the iron and the little loadstone be greater and quicker than the conjunction of the two steams which meet between the greater loadstone and the iron, the iron must stick to the lesser loadstone. And this must happen more often than otherwise: for the steam which goeth from the iron to the greater loadstone, will for the most part be less than the steam which goeth from the lesser loadstone to the iron. And though the other steam be never so great, yet it cannot draw more than according to the proportion of its Antagonists coming from the iron. Wherefore seeing the two steams betwixt the iron and the little loadstone are more proportionable to one another, and the steam coming out of the little loadstone is notably greater than the steam going from the iron to the greater loadstone; the conjunction must be made for the most part to the little loadstone. And if this discourse doth not hold

in the former part of the Probleme, betwixt a second iron and a loadstone, it is supplied by the former reason which we gave for that particular purpose.

The third case dependeth also of this solution; for the bigger an iron is, so many more parts it hath to suck up the influence of the loadstone; and consequently, doth it thereby the more greedily: and therefore the loadstone must be carried to it more violently, and when they are joyned stick more strongly.

9. Why the variation of a touched needle from the north, is greater, the neerer you go to the pole.

The sixth question is, Why the variations of the needle from the true north in the northern hemisphere, are greater the neerer you go to the pole, and lesser the neerer you approach to the equator. The reason whereof is plain in our doctrine; for considering that the magnetick virtue of the earth, streameth from the north towards the equator; it followeth of necessity, that if there be two streams of magnetick fluours issuing from the north, one of them precisely from the pole, and the other from a part of the earth neer the pole; and that the stream coming from the point by side the pole, be but a little the stronger of the two; there will appear very little differencies in their several operations, after they have had a long space to mingle their emanations together; which thereby do joyn and grow as it were into a stream. Whereas the neerer you come to the pole, the more you will find them severed, and each of them working by its own virtue. And very neer the point which causeth the variation, each stream worketh singly by it self; and therefore here the point of variation must be master, and will carry the needle strongly unto his course from the due north, if his stream be never so little more efficacious than the other.

Again, a line drawn from a point of the earth wide of the pole, to a point of the meridiam neer the equator, maketh a less angle, than a line drawn from the same point of the earth, to a point of the same meridian neerer the pole: wherefore the variation being esteemed by the quantities of the said angles, it must needs be greater neer the pole, than neer the equator, though the cause be the same.

Which a little figure will presently explicate. Let the point A, be the pole; and the line A B, the meridian; and the point B the intersection of it, with a parallel neer the equator; and the point C the intersection of the Meridian with the Tropick;



pick; and D, a point in the earth neer the pole, unto which in the said intersection the needle tendeth, instead of looking directly to the pole, whereby it maketh variation from due north. I say then that the variation of a needle neer the equator in the point B, looking upon the point D, cannot be so great and sensible, as the variton of a needle in the Tropick C, looking upon the same point; since the angle D B A, which is made by the variation of the first, is less than the angle DCA, which is made by the variation of the latter needle, neerer the pole.

But because it may happen, that in the parts neer the equator, the variation may proceed from some piece of land, not much more northerly than where the needle is; but that beareth rather easterly or westerly from it; and yet *Gilberts* assertion goeth universally, when he saith the variations in southern regions are less than in northern ones; we must examine what may be the reason thereof. And presently the generation of the loadstone sheweth it plainly: for seeing the nature of the loadstone proceedeth out of this, that the Sun worketh more upon the Torrid Zone, than upon the poles; and that his too strong operation is contrary to the loadstone, as being of the nature of fire; it followeth evidently, that the lands of the Torrid Zone cannot be so magnetical (generally speaking) as the polar lands are; and by consequence, that a lesser land neer the pole, will have a greater effect, than a larger continent neer the equator: and likewise a land farther off towards the pole, will work more strongly than a nearer land which lyeth towards the equator.

10. Whether in the same part of the world a touched needle may at one time vary more from the north, and at another time less.

The seventh question is, Whether in the same part of the world a touched needle may at one time vary more from the true north point, and at another time less? In which *Gilbert* was resolute for the negative part: but our latter Mathematicians are of another mind. Three experiences were made neer *London* in three divers years. The two first 42 years distant from one another; and the third 12 years distant from the second. And by them it is found, that in the space of 54 years, the loadstone hath at *London* diminished his variation from the north, the quantity of 7 degrees and more. But so that in the latter years the diminution hath sensibly gone faster than in the former

Those

Theſe obſervations peradventure are but little credited by ſtrangers; but we who know the worth of the men that made them, cannot miſtruſt any notable error in them: for they were very able Mathematicians, and they made their obſervations with very great exactneſs; and there were ſeveral judicious witneſſes at the making of them; as may be ſeen in Maſter *Gillebrand* his print concerning this ſubject. And divers other particular perſons do confirm the ſame; whoſe credit, though each ſingle might peradventure be ſlighted, yet all in body make a great acceſſion.

We muſt therefore caſt about to finde what may be the cauſe of an effect ſo paradox to the reſt of the doctrine of the loadſtone: for ſeeing that no one place can ſtand otherwiſe to the north of the earth at one time than another; how is it poſſible that the needle ſhould receive any new variation, ſince all variation proceedeth out of the inequality of the earth? But when we conſider that this effect proceedeth not out of the main body of the earth, but onely out of the bark of it; and that its bark may have divers tempers not as yet diſcovered unto us; and that out of the variety of theſe tempers, the influence of the earthy parts may be divers in reſpect of one certain place; it is not impoſſible but that ſuch variation may be, eſpecially in *England*: which Iſland lying open to the north, by a great and vaſt Ocean, may receive more particularly than other places the ſpecial influences and variation of the weather, that happen in thoſe north-eaſtern countreys from whence this influence cometh unto us. If therefore there ſhould be any courſe of weather, whoſe period were a hundred years (for example) or more or leſs and ſo might eaſily paſs unmarked; this variation might grow out of ſuch a courſe.

But in ſo obſcure a thing, we have already hazarded to gueſs too much. And upon the whole matter of the loadſtone, it ſerveth our turn, if we have proved (as we conceive we have done fully) that its motions which appear ſo admirable, do not proceed from an occult quality; but that the cauſes of them may be reduced unto local motion; and that all they may be performed by ſuch corporeal inſtruments and means (though peradventure more intricately diſpoſed) as all other effects are among bodies. Whoſe ordering and diſpoſing and particular progreſs, there

there is no reaſon to deſpair of finding out; would but men carefully apply themſelves to that work, upon ſolid principles and with diligent experiences.

But becauſe this matter hath been very long, and ſcatteringly diffuſed in many ſeveral branches; peradventure it will not be diſpleaſing to the Reader to ſee the whole nature of the loadſtone ſummed up in ſhort. Let him then caſt his eyes upon one effect of it, that is very eaſie to be tried, and is acknowledged by all writers; though we have not as yet mentioned it. And it is, that a knife drawn from the pole of a loadſtone towards the equator, if you hold the point towards the pole, it gaineth a reſpect to one of the poles: but contrariwiſe, if the point of the knife be held towards the equator, and be thruſt the ſame way it was drawn before (that is, towards the equator) it gaineth a reſpect towards the contrary pole.

11. The whole doctrine of the loadſtone ſummed up in ſhort.

It is evident out of this experience, that the virtue of the loadſtone is communicated by way of ſtreams; and that in it, there are two contrary ſtreams: for otherwiſe the motion of the knife this way or that way could not change the efficacity of the ſame parts of the loadſtone. It is likewiſe evident, that theſe contrary ſtreams do come from the contrary ends of the loadſtone. As alſo that the virtues of them both are in every part of the ſtone. Likewiſe that one loadſtone muſt of neceſſity turn certain parts of it ſelf, to certain parts of another loadſtone; nay, that it muſt go and joyn to it, according to the laws of attraction which we have above delivered: and conſequently, that they muſt turn their diſagreeing parts away from one another; and ſo one loadſtone ſeem to fly from another, if they be ſo applied that their diſagreeing parts be kept ſtill next to one another: for in this caſe, the diſagreeing and the agreeing parts of the ſame loadſtone, being in the ſame ſtraight line, one loadſtone ſeeking to draw his agreeing part neer to that part of the other loadſtone which agreeth with him, muſt of neceſſity turn away his diſagreeing parts to give way unto his agreeing part to approach neerer.

And thus you ſee that the flying from one another of two ends of two loadſtones, which are both of the ſame denomination (as for example, the two ſouth ends, or the two north ends) doth not proceed from a pretended antipathy between thoſe

those two ends, but from the attraction of the agreeing ends.

Farthermore, the earth, having to a loadstone the nature of a loadstone; it followeth that a loadstone must necessarily turn it self to the poles of the earth by the same laws. And consequently, must tend to the north, must vary from the north, must incline towards the center, and must be affected with all such accidents as we have deduced of the loadstone.

And lastly, seeing that iron is to a loadstone, a fit matter for it to impress its nature in, and easily retaineth that magnetick virtue; the same effects that follow between two loadstones, must necessarily follow between a loadstone, and a piece of iron fitly proportionated in their degrees: excepting some little particularities, which proceed out of the naturalness of the magnetick virtue to a loadstone, more than to iron.

And thus you see the nature of the loadstone summed up in gross; the particular joynts and causes whereof, you may finde treated at large in the main discourse. Wherein we have governed our selves chiefly by the experiences that are recorded by *Gilbert* and *Cabeus*; to whom, we remit our reader for a more ample declaration of particulars.

CHAP. XXIII.

A description of the two sorts of living Creatures; Plants, and Animals: and how they are framed in common to perform vital motion.

1. The connexion of the following Chapters with the precedent ones.

Hitherto we have endeavoured to follow by a continual thrid, all such effects as we have met with among bodies, and to trace them in all their windings, and to drive them up to their very root and original source: for the nature of our subject having been yet very common, hath not exceeded the compass and power of our search and inquiry, to descend unto the chief circumstances and particulars belonging unto it. And indeed, many of the conveiances whereby the operations we have discoursed of, are performed, be so secret and abstruse, as they that look into them with less heedfulness, and judgement than such a matter requireth, are too apt to impute them to mysterious causes above the reach of human nature to comprehend, and to calumniate them of being wrought by occult and specifick qua-

qualities; whereof no more reason could be given, than if the effects were infused by Angelical hands without assistance of inferiour bodies, which useth to be the last refuge of ignorant men, who not knowing what to say, and yet presuming to say something, do fall often upon such expressions, as neither themselves nor their hearers understand; and that if they be well scanned, do imploy contradictions. Therefore we deemed it a kind of necessity to strain our selves to prosecute most of such effects, even to their notional connexions with rarity and density. And the rather, because it hath not been our luck yet to meet with any that hath had the like design, or hath done any considerable matter to ease our pains. Which cannot but make the readers journey somewhat tedious unto him to follow all our steps, by reason of the ruggednes, and untrodeness of the paths we have walked in.

But now the effects we shall henceforward meddle withall, do grow so particular, and do swarm into such a vast multitude of several little joynts, and wreathy labyrinths of nature, as were impossible in so summary a treatise, as we intend, to deliver the causes of every one of them exactly; which would require both large discourses and abundance of experiences to acquit our selves as we ought of such a task. Nor is there a like need of doing it as formerly, for as much as concerneth our designe; since the causes of them palpably material, and the admirable artifice of them consisteth onely in the Dædalean and wonderfull ingenious ordering and ranging them one with another.

We shall therefore intreat our Reader from this time forwards to expect onely the common sequele of those particular effects, out of the principles already laid. And when some shall occur, that may peradventure seem at the first sight to be enacted immediately by a vertue spiritual, and that proceedeth indivisibly, in a different strain from the ordinary processes which we see in bodies and in bodily things (that is, by the virtues of rarity and density, working by local motion) we hope he will be satisfied at our hands, if we lay down a method, and trace out a course, whereby such events and operations may follow out of the principles we have laid. Though peradventure we shall not absolutely convince that every effect is done just as we set it down in every particular, and that it may not as well be done by some

some other disposing of parts under the same general scope: for it is enough for our turn, if we shew that such effects may be performed by corporeal agents, working as other bodies do, without confining our selves to an exactness in every link of the long chain that must be wound up in the performance of them

2. Concerning several compositions of mixed bodies.

To come then to the matter; The next thing we are to employ our selves about, now that we have explicated the natures of those motions by means whereof bodies are made and destroyed; and in which they are to be considered chiefly as passive, whiles some exterior agent working upon them causeth such alterations in them, and bringeth them to such pass as we see in the changes that are dayly wrought among substances; is to take a survey of those motions which some bodies have, wherein they seem to be not so moch patients as agents; and do contain within themselves the principle of their own motion; and have no relation to any outward object, more than to stir up that principle of motion, and set it on work: which when it is once in act, hath as it were within the limits of its own kingdom, and severed from commerce with all other bodies whatsoever, many other subaltern motions over which it presideth.

To which purpose we may consider, that among the compounded bodies whose natures we have explicated, there are some in whom the parts of different complexions are so small and so well mingled together, that they make a compound which to our sense seemeth to be all of it quite through of one homogeneous nature; and howsoever it be divided, each part retaineth the entire and complete nature of the whole. Others again there are, in which it is easie to discern that the whole is made up of several great parts of very differing natures and tempers.

And of these there are two kinds: the one, of such as their differing parts seem to have no relation to one another, or correspondence together to perform any particular work, in which all of them are necessary; but rather they seem to be made what they are by chance and by accident; and if one part be severed from another, each is an entire thing by it self, of the same nature as it was in the whole; and no harmony is destroyed by such division. As may be observed in some bodies digged out of mines, in which one may see lumps of metal, ore, stone,

and

and glass, and such different substances, in their several distinct situations, perfectly compacted into one continuate body, which if you divide, the glass remaineth what it was before, the Emerald is still an Emerald, the silver is good silver, and the like of the other substances; the causes of which may be easily deduced out of what we have formerly said. But there are other bodies in which this manifest and notable difference of parts, carrieth with it such a subordination of one of them unto another, as we cannot doubt but that nature made such engines (if so I may call them) by designe; and intended that this variety should be in one thing; whose unity and being what it is, should depend of the harmony of the several differing parts, and should be destroyed by their separation. As we see in living creatures, whose particular parts and members being once severed, there is no longer a living creature to be found among them.

3. Two sorts of living creatures.

Now of this kind of bodies there are two sorts. The first is of those that seem to be one continuate substance, wherein we may observe one and the same constant progress throughout, from the lowest unto the highest part of it; so that the operation of one part is not at all different from that of another: but the whole body seemeth to be the course and throughfare of one constant action, varying it self in divers occasion and occurrences, according to the disposition of the subject.

The bodies of the second sort, have their parts so notably separated one from the other; and each of them have such a peculiar motion proper unto them, that one might conceive they were every one of them a complete distinct total thing by it self, and that all of them were artificially tied together; were it not that the subordination of these parts to one another is so great, and the correspondence between them so strict, (the one not being able to subsist without the other, from whom he deriveth what is needfull for him: and again, being so usefull unto that other, and having its action and motion so fitting and necessary for it, as without it, that other cannot be:) as plainly convinceth that the compound of all these several parts must needs be one individual thing.

4. An engine to expres the first sort of living creatures.

I remember that when I travelled in *Spain*, I saw there two engines that in some sort do expres the natures of these two kinds of bodies. The one at *Tolledo*, the other at *Segovia*: both of

of them set on work by the current of the river, in which the foundation of their machine was laid. That at *Toledo* was to force up water a great height from the river *Tagus* to the *Alcazar* (the kings palace) that standeth upon a high steep hill or rock, almost perpendicular over the river. In the bottom there was an intended wheel, which turning round with the stream, gave motion at the same time to the whole engine; which consisted of a multitude of little troughs or square ladles set one over another in two parallel rows over against one another, from the bottom to the top, and upon two several divided frames of timber. These troughs were closed at one end with a traverse board to retain the water from running out there; which end being bigger than the rest of the trough, made it somewhat like a ladle; and the rest of it seemed to be the handle with a channel in it, the little end of which channel or trough was open to let the water pass freely away. And these troughs were fastened by an axletree in the middle of them, to the frame of timber that went from the bottom up to the top: so that they could upon that center move at liberty, either the shut end downwards, or the open end; like the beam of a balance.

Now at a certain position of the root-wheel (if so I may call it) all one side of the machine sunk down a little lower towards the water, and the other was raised a little higher. Which motion was changed as soon as the ground-wheel had ended the remnant of his revolution: for then the side that was loweſt before sprung up, and the other sunk down. And thus the two sides of the machine were like two legs that by turns trod the water; as in the vintage men press grapes in a vate. Now the troughs that were fastened to the timber which descended, turned that part of them downwards, which was like a box shut to hold the water: and consequently, the open end was up in the air; like the arm of the balance unto which the lighteſt scale is fastened: and in the mean time, the troughs upon the ascending timber, were moved by a contrary motion; keeping their box ends aloft, and letting the open ends incline downwards: so that if any water were in them, it would let it run out; whereas the others retayned any that came into them.

When you have madr an image of this machine in your phantasie,

phantasie, consider what will follow out of its motion. You will perceive that when one leg sinketh down towards the water, that trough which is next to the superficies of it, putting down his box end, and dipping it a little in the water; must needs bring up as much as it can retain, when that leg ascendeth: wch when it is at its height, the trough moveth upon his own center, and the box end, which was lowest, becometh now highest, and so the water runneth out of it. Now the other leg descending at the same time, it falleth out that the trough on its side, which would be a step above that which hath the water in it, if they stood in equilibrity, becometh now a step lower than it: and is so placed, that the water which runneth out of that which is aloft, falleth into the head or box of it; which no sooner hath received it, but that leg on which it is fastned, springeth up, and the other descendeth: so that the water of the second leg, runneth now into the box of the first leg, that is next above that which first laded the water out of the river. And thus, the troughs of the two legs deliver their water by turns from the one side to the other; and at every remove, it getteth a step upwards, till it commeth to the top; whiles at every ascent and descent of the whole side, the lowest ladle or trough taketh new water from the river: which ladlefull followeth immediately in its ascent, that which was taken up the time before. And thus, in a little while, all the troughs from the bottome to the top are full; unless there happen to be some failing in some ladle; and in that case the water breaketh out there; and all the ladles above that are dry.

5. Another engine by which may be expressed the second sort of living creatures.

The other engine, or rather multitude of several engines, to perform sundry different operations, all conducing to one work (whereas, that of *Toledo*, is but one tenour of motion, from the first to the last;) is in the mint at *Segovia*. Which is so artificially made, that one part of it, distendeth an ingot of silver or gold into that breadth and thickness as is requisite to make coyn of. Which being done, it delivereth the plate it hath wrought, unto another that printeth the figure of the coyn upon it. And from thence it is turned over to another that cutteth it according to the print, into due shape and weight. And lastly, the several pieces fall into a reserve, in another room: where the officer, whose charge it is, findeth treasure ready coined; without any thing there, to informe him of the several

different motions that the silver or the gold passed before they came to that state. But if he go on the other side of the wall, into the room where the other machines stand and are at work, he will then discern that every one of them, which considered by it self might seem a distinct complete engine, is but a serving part of the whole; whose office is, to make money: and that for this work, any one of them separated from the rest, ceaseth to be the part of a mint, and the whole is maimed and destroyed.

6. The two former engines and some other comparisons applied to express the two several sorts of living creatures.

Now let us apply the consideration of these different kinds of engines, to the natures of bodies we treat of. Which I doubt not, would fit much better, were they lively and exactly described. But it is so long since I saw them, and I was then so very young, that I retain but a confused and clowdy remembrance of them: especially of the mint at *Segovia*, in the which there are many more particulars than I have touched; as conveniency for refining the ore or metal; and then casting it into ingots; and driving them into rods, and such like: unto all which, there is little help of hands requisite, more than to apply the matter duly at the first. But what I have said of them, is enough to illustrate what I aim at: and though I should err in the particulars, it is no great matter, for I intend not to deliver the history of them: but onely out of the remembrance of such notefull and artificial masterpieces, to frame a model in their phancies that shall read this, of something like them; whereby they may with more ease, make a right conception of what we are handling.

Thus then; all sorts of plants, both great and small, may be compared to our first ingine of the water-work at *Tolledo*; for in them all the motion we can discern, is of one part transmitting unto the next to it, the juice which it received from that immediatly before it: so that it it hath one constant course from the root (which sucketh it from the earth) unto the top of the highest sprig: in which if it should be intercepted and stopped by any maiming of the bark (the chanel it ascendeth by) it would there break out and turn into drops, or gum, or some such other substance as the nature of the plant requireth; and all that part of it unto which none of this juice can ascend would dry and wither and grow dead.

But sensible living creatures, we may fitly compare to the second machine of the mint at *Segovia*. For in them, though every part

part and member be as it were a complete thing of it self, yet every one requireth to be directed and put on in its motion by another; and they must all of them (though of very different natures and kinds of motion) conspire together to effect any thing that may be for the use and service of the whole. And thus we find in them perfectly the nature of a mover and a moveable; each of them moving differently from one another, and framing to themselves their own motions, in such sort as is most agreeable to their nature, when that part which setteth them on work hath stirred them up.

And now because these parts (the movers and the moved) are parts of one whole; we call the intire thing *automatum*, or *se movens*, or a living creature. Which also may be fitly compared to a joyner, or a painter, or other craftsmen, that had his tools so exactly fitted about him, as when he had occasion to do any thing in his trade, his tool for that action were already in the fittest position for it, to be made use of, so as without removing himself from the place where he might sit invironed with his tools, he might, by onely pulling of some little chords, either apply the matter to any remote toole, or any of his tools to the matter he would work upon, according as he findeth the one or the other more convenient for performance of the action he intendeth.

Whereas in the other, there is no variety of motions; but one and the same goeth quite through the body from one end of it to the other. And the passage of the moisture through it, from one part to another next (which is all the motion it hath) is in a manner but like the rising of water in a Still, which by heat is made to creep up by the sides of the glass; and from thence runneth through the nose of the limbeck, and falleth into the Receiver. So that, if we will say that a plant liveth, or that the whole moveth it self, and every part moveth other; it is to be understood in a far more imperfect manner, than when we speak of an animal: and the same words are attributed to both, in a kind of equivocal sense. But by the way I must note, that under the title of plants I include not zoophytes or plantanimals, that is such creatures as though they go not from place to place, and so cause a local motion of their whole substance, yet in their parts, they have a distinct and articulate motion.

But to leave comparisons, and come to the proper nature of the

7 How plants are framed.

things: let us frame a conception, that not far under the superficies of the earth, there were gathered together divers parts of little mixed bodies, which in the whole sum were yet but little: and that this little mass had some excess of fire in it, such as we see in wet hay, or in muste of wine, or in woort of beer: and that withall the drought of it were in so high a degree, as this heat should not find means (being too much compressed) to play his game: and that, lying there in the bosome of the earth, it should after some little time receive its expected and desired drink through the benevolence of the heaven; by which it being moistned, and thereby made more pliable, and tender and easie to be wrought upon, the little parts of fire should break loose; and they finding this moisture a fit subject to work upon, should drive it into all the parts of the little mass, and digesting it there, should make the mass swel. Which action taking up long time for performance of it, in respect of the small increase of bulk made in the mass by the swelling of it; could not be hindred by the pressing of the earth, though lying never so weightily upon it: according to the maxim we have above delivered, that any little force, be it never so little, is able to overcome any great resistance, be it never so powerfull, if the force do multiply the time it worketh in, sufficiently to equalise the proportions of the agent and the resistant.

This increase of bulk and swelling of the little mass, will of its own nature be towards all be sides, by reason of the fire and heat that occasioneth it (whose motion is on every side, from the center to the circumference:) but it will be most efficacious upwards, towards the air, because the resistance is least that way; both by reason of the little thickness of the earth over it; as also by reason that the upper part of the earth lieth very loose and is exceeding porous, through the continual operation of the sun and falling of rain upon it. It cannot choose therefore but mount to the air; and the same cause that maketh it do so, presseth at the same time the lower parts of the mass, downwards. But what ascendeth to the air, must be of the hotter and more moist parts of the fermenting mass; and what goeth downwards must be of his harder and drier parts proportionate to the contrary motions of fire and of earth, which predominate in these two kinds of parts. Now this that is pushed upwards, coming

coming above ground, and being there expoſed to ſun and wind, contracteth thereby a hard and rough skin on its outſide, but within is more tender; in this ſort it defendeth it ſelf from outward injuries of weather whiles it mounteth: and by thruſting other parts down into the earth, it holdeth it ſelf ſtedfaſt, that although the wind may ſhake it, yet it cannot overthrow it. The greater this plant groweth, the more juyce is daily accrued unto it, and the heat is encreaſed; and conſequently, the greater abundance of humours is continually ſent up. Which when it beginneth to clog at the top, new humour preſſing upwards, forceth a breach in the skin; and ſo a new piece, like the main ſtem, is thruſt out, and beginneth on the ſides, which we call a branch. Thus is our plant amplified, till nature not being able ſtill to breed ſuch ſtrong iſſues, falleth to work of leſs labour, and puſheth forth the moſt elaborate part of the plants juyce into more tender ſubſtances, but eſpecially at the ends of the branches, where abundant humour, but at the firſt not well concocted, groweth into the ſhape of a button; and more and better concocted humour ſucceeding, it groweth ſofter and ſofter (the ſun drawing the ſubtileſt parts outwards) excepting what the coldneſs of the air, and the roughneſs of the wind do harden into an outward skin. So then the next parts to the skin are tender; but the very middle of this button muſt be hard and dry, by reaſon that the ſun from without, and the natural heat within, drawing and driving out the moiſture, and extending it from the center, muſt needs leave the more earthy parts much ſhrunk up and hardened by their evaporating out from them: which hardning, being an effect of fire within and without, that baketh this hard ſubſtance, incorporateth much of it ſelf with it, as we have formerly declared in the making of ſalt by force of fire. This button, thus dilated, and brought to this paſs, we call the fruit of the plant, whoſe harder part encloſeth oftentimes another not ſo hard as dry. The reaſon whereof is, becauſe the outward hardneſs permitteth no moiſture to ſoak in any abundance through it; and then, that which is encloſed in it, muſt needs be much dried; though not ſo much, but that it ſtill retaineth the common nature of the plant. This drought maketh theſe inner parts to be like a kind of duſt; or at the leaſt, ſuch as

may be easily dried into dust, when they are bruised out of the husk that incloseth them. And in every parcel of this dust, the nature of the whole resideth, as it were contracted into a small quantity; for the juyce which was first in the button, and had passed from the root through the manifold varieties of the divers parts of the plant, and had suffered much concoction, partly from the sun, and partly from the inward heat imprisoned in that harder part of the fruit, is by these passages, strainings and concoctions, become at the length to be like a tincture extracted out of the whole plant; and is at the last dried up into a kinde of magistery. This we call the seed: which is of a fit nature, by being buried in the earth, and dissolved with humour, to renew and reciprocate the operation we have thus described. And thus, you have the formation of a plant.

8. How sensitive creatures are formed.

But a sensitive creature, being compared to a plant, as a plant is to a mixed body; you cannot but conceive that he must be compounded as it were of many plants, in like sort as a plant is of many mixed bodies. But so, that all the plants which concur to make one animal, are of one kinde of nature and cognation: and besides, the matter, of which such diversity is to be made, must of necessity be more humid and figurable, than that of an ordinary plant: and the artificer which worketh and mouldeth it, must be more active. Wherefore we must suppose that the mass, of which an animal is to be made, must be actually liquid: and the fire that worketh upon it, must be so powerfull, that of its own nature it may be able to convert this liquid matter into such breaths and steams, as we see do use to rise from water, when the sun or fire worketh upon it. Yet if the mass were altogether as liquid as water, it would vanish away by heat boyling it, and be dried up: therefore it must be of such a convenient temper, that although in some of its parts it be fluid and apt to run, yet by others it must be held together; as we see that unctuous things for the most part are; which will swell by heat, but not flie away.

So then, if we imagine a great heat to be imprisoned in such a liquor; and that it seeketh, by boyling, to break out, but that the solidness and viscuousness of the substance will not permit it to evaporate; it cannot choose but comport it self in some such sort as we see butter or oyl in a frying-pan over the fire, when it

it riseth in bubbles, but much more efficaciously; for their body is not strong enough to keep in the heat; and therefore those bubbles fall again; whereas if it were, those bubbles would rise higher and higher, and stretch themselves longer and longer (as when the soap-boylers do boyl a strong unctuous lye into soap;) and every one of them would be as it were a little brook, whereof the channel would be the enclosing substance; and the inward smoke that extendeth it, might be compared to the water of it: as when a glass is blown out by fire and air into a long figure.

Now we may remember, how we have said, where we treated of the production and resolution of mixed bodies, that there are two sorts of liquid substantial parts, which by the operation of fire are sent out of the body it worketh upon; the watery, and the oily parts. For though there appear sometimes some very subtil and ethereal parts of a third kind (which are the *aquæ ardentes*, or burning spirits;) yet in such a close distilling of circulation as this is, they are not severed by themselves, but do accompany the rest; and especially the watery parts, which are of a nature, that the rising ethereal spirits easily mingle with, and extend themselves in it; whereby the water becometh more efficacious, and the spirits less fugitive.

Of these liquid parts which the fire sendeth away, the watery ones are the first, as being the easiest to be raised: the oily parts rise more difficultly, and therefore do come last. And in the same manner it happeneth in this emission of brooks, the watery and oily streams will each of them flie into different reserves: and if there arrive unto them abundance of their own quality, each of them must make a substance of its own nature, by settling in a convenient place, and by due concoction. Which substance after it is made and confirmed, if more humidity and heat do press it, will again break forth into other little channels. But when the watery and oily parts are boiled away, there remain yet behind other more solid and fixed parts, and more strongly incorporated with fire than either of these: which yet cannot dry up into a fiery salt, because a continual accession of humour keepeth them alwaies flowing: and so they become like a cauldron of boyling fire. Which must propagate it self as wide as either of the others; since the

activity of it must needs be greater than theirs (as being the source of motion unto them) and that there wanteth not humidity for it to extend it self by.

And thus you see three roots of three divers plants, all in the same plant, proceeding by natural resolution from one primitive source. Whereof that which is most watry, is fittest to fabricate the body and common outside of the triformed plant; since water is the most figurable principle that is in nature, and the most susceptible of multiplication; and by its cold is easiest to be hardened, and therefore fittest to resist the injuries of enemy-bodies that may infest it. The oily parts are fittest for the continuance and solidity of the plant: for we see that viscuosity and oilyness hold together the parts where they abound; and they are slowly wasted by fire, but do conserve, and are an aliment to the fire that consumeth them. The parts of the third kinde are fittest for the conservation of heat: which though in them it be too violent, yet it is necessary for working upon other parts, and for maintaining a due temper in them.

And thus we have armed our plant with three sorts of rivers or brooks to run through him, with as many different streams; the one of a gentle balsamike oyl; another, of streaming fire; and the third, of a connatural and cooler water to irrigate and temper him. The streams of water, (as we have said) must run through the whole fabrick of this triformed plant: and because it is not a simple water, but warm in a good degree, and as it were a middle substance betwixt water and air (by reason of the ardent volatile spirit that is with it) it is of a fit nature to swell, as air doth; and yet withall to resist violence in a convenient degree, as water doth. Therefore if from its source nature sendeth abundance into any one part; that part must swell and grow thicker and shorter; and so must be contracted that way which nature hath ordered it. Whence we perceive a means by which nature may draw any part of the outward fabrick, which way soever she is pleased, by set instruments for such an effect. But when there is no motion, or but little in these pipes, the standing stream that is in a very little, though long chanel, must needs be troubled in its whole body, if any one part of it be pressed upon, so as to receive thereby any impression: and therefore

fore whatsoever is done upon it, though at the very farthest end of it, maketh a commotion, and sendeth an impression up to its very source. Which appearing by our former discourse to be the origine of particular and occasional motions; it is obvious to conceive how it is apt to be moved and wrought by such an impression to set on foot the beginning of any motion; which by natures providence is convenient for the plant, when such an impression is made upon it.

And thus you see this plant hath the virtue both of sense or feeling; that is, of being moved and affected by extern objects, lightly striking upon it; as also of moving it self, to or from such an object; according as nature shall have ordained. Which in sum is, That this plant is a sensitive creature, composed of three sources, the heart, the brain, and the liver: whose offsprings are the arteries, the nerves, and the veins; which are filled with vital spirits, with animal spirits, and with blood: and by these the animal is heated, nourished, and made partaker of sense and motion.

Now referring the particular motion of living creatures, to another time: we may observe, that both kinds of them, as well vegetables as animals, do agree in the nature of sustaining themselves in the three common actions of generation, nutrition, and augmentation; which are, the beginning, the progress, and the conserving of life. Unto which three we may add, the not so much action as passion of death, and of sickness or decay, which is the way to death.

CHAP. XXIV.

A more particular survey of the generation of Animals, in which is discovered what part of the Animal is first generated.

TO begin then with examining how living creatures are ingendered: our main question shall be, Whether they be framed entirely at once; or successively, one part after another? And if this latter way, which part first? Upon the discussion of which, all that concerneth generation will be explicated, as much as concerneth our purpose in hand. To reduce this from its origine, we may remember how our Masters tell us, that when any living creature is passed the heat of its augmentation or grow-

1. The opinion, That the seed containeth formally every part of the parent.

growing: the ſuperfluous nouriſhment ſettleth it ſelf in ſome appointed place of the body to ſerve for the production of ſome other. Now it is evident, that this ſuperfluity cometh from all parts of the body, and may be ſaid to contain in it after ſome ſort the perfection of the whole living creature. Be it how it will, it is manifeſt that the living creature is made of this ſuperfluous moiſture of the parent: which, according to the opinion of ſome, being compounded of ſeveral parts derived from the ſeveral limbs of the parent; thoſe parts when they come to be fermented in convenient heat and moyſture, do take their poſture and ſituation, according to the poſture and diſpoſition of parts that the living creature had from whence they iſſued: and then they growing daily greater and ſolider, (the effects of moiſture and of heat;) do at the length become ſuch a creature as that was, from whence they had their origine.

Which an accident that I remember, ſeemeth much to confirm. It was of a cat that had its tail cut off when it was very young: which cat happening afterwards to have young ones, half the kitlings proved without tails, and the other half had them in an ordinary manner; as if nature could ſupply but one partners ſide, not on both. And another particular that I ſaw when I was at *Argiers*, maketh to this purpoſe, which was of a woman, that having two thumbs upon the left hand; four daughters that ſhe had did all reſemble her in the ſame accident, and ſo did a little child, a girl of her eldeſt daughters; but none of her ſons. Whiles I was there, I had a particular curioſity to ſee them all: and though it be not eaſily permitted unto Chriſtians to ſpeak familiarly with Mahometan women; yet the condition I was in there, and the civility of the Baſſha, gave me the opportunity of full view and diſcourſe with them: and the old woman told me, that her mother and grandmother had been in the ſame manner. But for them, it reſteth upon her credit; the others I ſaw my ſelf.

2. The former opinion rejected.

But the opinion which theſe accidents ſeem to ſupport, though at the firſt view it ſeemeth ſmoothly to ſatisfie our inquiry, and fairly to compaſs the making of a living creature: yet looking farther into it, we ſhall find it fall exceeding ſhort of its promiſing; and meet with ſuch difficulties, as it cannot overcome. For firſt, let us caſt about how this compound of ſeveral parts, that

ſerves

ſerves for the generation of a new living creature, can be gathered from every part and member of the parent; ſo to carry with it in little the compleat nature of it. The meaning hereof muſt be, that this ſuperfluous aliment, either paſſeth through all and every little part and particle of the parents body, and in its paſſage receiveth ſomething from them: or elſe, that it receiveth onely from all ſimilar and great parts.

The former ſeemeth impoſſible; for how can one imagine that ſuch juyce ſhould circulate the whole body of an animal, and viſit every atom of it, and retire to the reſerve where it is kept for generation; and no part of it remain abſolutely behind, ſticking to the fleſh or bones that it bedeweth; but that ſtill ſome part returneth back from every part of the animal? Beſides, conſider how thoſe parts that are moſt remote from the channels which convey this juyce; when they are fuller of nouriſhment than they need, the juyce which overfloweth from them, cometh to the next part, and ſetling there, and ſerving it for its due nouriſhment, driveth back into the channel, that which was betwixt the channel and it ſelf; ſo that here there is no return at all from ſome of the remote parts; and much of that juyce which is rejected, never went far from the channel it ſelf. We may therefore ſafely conclude, That it is impoſſible every little part of the whole body ſhould remit ſomething impregnated and imbued with the nature of it.

But then you may peradventure ſay, That every ſimilar part doth. If ſo, I would ask, How it is poſſible that by fermentation onely, every part ſhould regularly go to a determinate place, to make that kind of animal in which every ſimilar part is diffuſed to ſo great an extent? How ſhould the nature of fleſh here become broad, there round, and take juſt the figure of the part it is to cover? How ſhould a bone here be hollow, there be blady, and in another part take the form of a rib, and thoſe many figures which we ſee of bones? And the like we might ask of every other ſimilar part, as of the veins and the reſt. Again, ſeeing it muſt of neceſſity happen, that at one time more is remitted from one part than from another; how cometh it to paſs, that in the collection the due proportion of nature is ſo punctually obſerved? Shall we ſay, that this is done by ſome cunning artificer, whoſe work it is to ſet all theſe parts in their due poſture; which

Ariſtotle

Aristotle attributeth to the seed of the male? But this is impossible; for all this diversity of work is to be done at one time, and in the same occasion: which can no more be effected by one agent, than multiplicity can immediately proceed from unity.

But besides that there can be no agent to dispose of the parts when they are gathered; it is evident that a sensitive creature may be made without any such gathering of parts beforehand from another of the same kind: for else, how could vermine breed out of living bodies, or out of corruption? How could rats come to fill ships, into which never any were brought? How could frogs be ingendred in the air? Eels of dewy turfs, or of mud? Toads of Ducks? Fish of Herns? And the like. To the same purpose, when one species or kind of animal is changed into another; as when a caterpiller or a silk-worm becometh a flie; it is manifest that there can be no such precedent collection of parts.

3. The Authours opinion of this question.

And therefore there is no remedy but we must seek out some other means and course of generation, than this. Unto which we may be lead, by considering how a living creature is nourished and augmented: for why should not the parts be made in generation of a matter like to that which maketh them in nutrition? If they be augmented by one kind of juyce that after several changes turneth at the length into flesh and bone, and into every sort of mixed body or similar part, whereof the sensitive creature is compounded, and that joyneth it self to what it findeth already made, why should not the same juyce with the same progress of heat and moisture, and other due temperaments, be converted at the first into flesh and bone, though none be formerly there to joyn it self unto?

Let us then conclude, that the juyce which serveth for nourishment of the animal, being more than is requisite for that service, the superfluous part of it is drained from the rest, and is reserved in a place fit for it: where by little and little, through digestion, it gaineth strength, and vigour, and spirits to it self, and becometh an homogeneal body, such as other simple compounds are; which by other degrees of heat and moisture, is changed into another kind of substance: and that again by other temperaments into another. And thus, by the course of nature, and by passing successively many degrees of temper, and by receiving a total change

change in every one of them; at the length an animal is made of such juyce as afterwards serveth to nourish him.

But to bring this to pass a shorter way, and with greater facility; some have been of opinion, that all similar things of whatsoever substance, are, undiscernably mixed in every thing that is: and that to the making of any body out of any thing, there is no more required but to gather together those Parts which are of that kind, and to separate, and cast away from them, all those which are of a nature differing from them. 4. Their opinion refuted, who hold that every thing containeth formally all things.

But this speculation will appear a very airy and needless one, if we consider into how many several substances the same species of a thing may be immediately changed; or rather how many several substances may be increased immediately from several equal individuals of the same thing; and then take an account how much of each individual is gone into each substance which it hath so increased. For if we sum up the quantities that in the several substances are thereby encreased, we shall find that they do very much exceed the whole quantity of any one of the individuals: which should not be if the supposition were true; for every individual should be but one total made up of the several different similar parts, which encrease the several substances, that extract out of them what is of their own nature.

This will be better understood by an example: suppose that a man, a horse, a cow, a sheep, and 500. more several species of living creatures, should make a meal of lettuce: to avoid all perplexity in conceiving the argument, let us allow that every one did eat a pound; and let us conceive another pound of this herb to be burned; as much to be putrified under a cabage root; and the like under 500 plants more of divers species. Then cast how much of every pound of lettuce is turned into the substances that are made of them, or that are encreased by them; as, how much ashes one pound hath made; how much water hath been distilled out of another pound; how much a man hath been encreased by a third; how much a horse by a fourth; how much earth by the putrefaction of a fifth pound; how much a cabage hath been encreased by a sixth: and so go over all the pounds that have been turned into substances of different specieses (which may be multiplied as much as you please.) And when you have summed up all

all these several quantities, you will find them far to exceed the quantity of one pound: which it would not do, if every pound of letuce were made up of several different similar parts actually in it, that are extracted by different substances of the natures of those parts; and that no substance could be encreased by it, unless parts of its nature were originally in the letuce.

5. The Auhours opinion concerning the generation of animals declared and confirmed.

On the other side, if we but cast our eye back upon the principles we have laid, where we discourse of the composition of bodies; we shall discern how this work of changing one thing into another, either in nutrition, in augmentation, or in generation, will appear not onely possible, but easie to be effected. For out of them it is made evident how the several varieties of solid and liquid bodies, all differences of natural qualities, all consistences, and whatsoever else belongeth to similar bodies, resulteth out of the pure and single mixture of rarity and density; so that to make all such varieties as are necessary, there is no need of mingling, or of separating any other kinds of parts: but onely an art or power to mingle in due manner, plain, rare, and dense bodies one with an other. Which very action and none other (but with excellent method and order, such as becometh the great Architect that hath designed it) is performed in the generation of a living creature: which is made of a substance at the first, far unlike what it afterwards groweth to be.

If we look upon this change in gross, and consider but the two extremes (to wit, the first substance, of which a living creature is made, and it self in its full perfection) I confess, it may well seem incredible how so excellent a creature can derive its origine from so mean a principle, and so far remote and differing from what it groweth to be. But if we examine it in retail, and go along anatomising it in every step and degree that it changeth by; we shall find that every immediate change is so near, and so palpably to be made by the concurrent causes of the matter prepared; as we must conclude it cannot possibly become any other thing than just what it doth become.

Take a bean, or any other seed, and put it into the earth, and let water fall upon it; can it then choose but that the bean must swell? The bean swelling, can it choose but break the skin? The skin broken, can it choose (by reason of the heat that is in it)

but

but push out more matter, and do that action which we may call germinating? Can these germs choose but pierce the earth in small strings, as they are able to make their way? Can these strings choose but be hardened, by the compression of the earth, and by their own nature, they being the heaviest parts of the fermented bean? And can all this be any thing else but a root? Afterwards the heat that is in the root, mingling it self with more moisture, and according to its nature, springing upwards, will it not follow necessarily, that a tender green substance (which we call a bud, or leaf) must appear a little above the earth; since tenderness, greeness, and ascent, are the effects of those two principles, heat and moisture? And must not this green substance change from what it was at the first, by the sun and air working upon it, as it groweth higher; till at the length it hardeneth into a stalk? All this while, the heat in the root sublimeth up more moisture, which maketh the stalk at the first grow rank and encrease in length: But when the more volatile part of that warm juice, is sufficiently depured and sublimed, will it not attempt to thrust it self out beyond the stalk with much vigour and smartness? And as soon as it meeteth with the cold air in its eruption, will it not be stopped and thickned? And new parts flocking still from the root, must they not clog that issue, and grow into a button, which will be a bud? This bud being hardened at the sides, by the same causes which hardened the stalk, and all the while the inward heat still streaming up, and not enduring to be long enclosed, (especially when by its being stopped it multiplyeth it self) will it not follow necessarily that the tender bud must cleave, and give way to that spiritual juice; which being purer than the rest (through its great sublimation) sheweth it self in a purer and nobler substance than any that is yet made; and so becometh a flower? From hence, if we proceed as we have begun, and do weigh all circumstances, we shall see evidently that another substance must needs succeed the flower, which must be hollow and contain a fruit in it: and that this fruit must grow bigger and harder. And so, to the last period of the generation of new beans.

Thus by drawing the thrid carefully along through your fingers, and staying at every knot to examine how it is tyed; you see that this difficult progress of the generation of living creatures,

creatures, is obvious enough to be comprehended; and that the steps of it are possible to be set down; if one would but take the paine and afford the time that is necessary (less than that Philosopher, who for so many years gave himself wholly up to the single observing of the nature of bees) to note diligently all the circumstances in every change of it. In every one of which the thing that was, becometh absolutely a new thing; and is endewed with new properties and qualities different from those it had before, as Physicians from their certain experience do assure us. And yet every change is such, as in the ordinary and general course of nature (wherein nothing is to be considered, but the necessary effects following out of such Agents working upon such patients, in such circumstances) it is impossible that any other thing should be made of the precedent, but that which is immediately subsequent unto it.

Now if all this orderly succession of mutations be necessarily made in a bean, by force of sundry circumstances and external accidents; why may it not be conceived that the like is also done in sensible creatures; but in a more perfect manner, they being perfecter substances? Surely the progress we have set down is much more reasonable, than to conceive that in the meal of the bean are contained in little, several similar substances; as of a root, of a leaf, a stalk, a flower, a cod, fruit, and the rest; and that every one of these, being from the first still the same that they shall be afterwards, do but suck in more moisture from the earth, to swell and enlarge themselves in quantity. Or that in the seed of the male, there is already in act, the substance of flear of bone, of sinews, of veins, and the rest of those several similiar part which are found in the body of an animal; and that they are but extended to their due magnitude, by the humidity drawn from the mother, without receiving any substantial mutation from what they were originally in the seed.

Let us then confidently conclude, that all generation is made of a fitting, but remote, homogeneal compounded substance: upon which, outward agents, working in the due course of nature, do change it into another sustance quite different from the first, and do make it less homogeneal than the first was. And other circumstances & agents do change this second into a third; that third into a fourth; and so onwards, by successive mutations (that

(that still make every new thing become less homogeneal, than the former was, according to the nature of heat, mingling more and more different bodies together) until that substance be produced, which we consider in the period of all these mutations.

And this is evident out of many experiences: as for example in trees; the bark which is opposed to the north wind, is harder and thicker than the contrary side which is opposed to the south, and a great difference will appear in the grain of the wood; even so much, that skilfull people will by feeling and seeing a round piece of the wood after the tree is felled, tell you in what situation it grew, and which way each side of that piece looked. And *Josephus Acosta* writeth of a tree in *America*, that on the one side being situated towards great hills, and on the other being exposed to the hot Sun; the one half of it flourisheth at one time of the year, and the other half at the opposite season. And some such like may be the cause of the strange effects we sometimes see of trees, flourishing or bearing leafs at an unseasonable time of the year; as in particular, in the famous oke in the *New Forest*, and in some others in our Island: in which peradventure the soil they grow in, may do the same effect, as the winds and Sun did in the tree that *Acosta* maketh mention of. For we daily see how some soils are so powerfull over some kind of corn, that they will change the very nature of it; so that, you shall reap oats or rie, after you have sown wheat there.

Which sheweth evidently that since the outward circumstances can make the parts or the whole of any substance, become different from what they were at the first; generation is not made by aggregation of like parts to presupposed like ones: nor by a specifical worker within; but by the compounding of a seminary matter, with the juice which accrueth to it from without, and with the steams of circumstant bodies; which by an ordinary course of nature, are regularly imbibed in it by degrees; and which at every degree, do change it into a different thing, such an one as is capable to result out of the present compound, (as we have said before) until it arrive to its full perfection.

Which yet is not the utmost period of natures changes; for 6.

That one substance is changed into another.

from that, for example, from corn or an animal, it carrieth it on (still changing it) to be meal or a cadaver: from thence to be bread or durt: after that to be bloud or grass. And so, still turning about her wheel (which suffereth nothing to remain long in the state it is in) she changeth all substances from one into another. And by reiterated revolutions, maketh in time every thing of every thing: as when of mud she maketh tadpoles, and frogs of them; and afterwards, mud again of the frogs: or when she runneth a like progress; from earth to worms; and from them, to flies; and the like: so changing one animal into such another; as in the next precedent step, the matter in those circumstances is capable of being changed into; or rather (to say better) must necessarily be changed into.

To confirm this by experience; I have been assured, by one who was very exact in noting such things; that he once observed in *Spain*, in the spring season, how a stick lying in a moist place, grew in tract of time to be most of it a rotten durty matter; and that at the durty end of the stick, there began a rude head to be formed of it by little and little; and after a while some little legs began to discover themselves neer this unpolished head, which daily grew more and more distinctly shaped. And then, for a pretty while (for it was in a place where he had the conveniency to observe daily the progress of it, and no body came neer to stir it in the whole course of it) he could discern where it ceased to be a body of a living creature, and where it began to be dead stick or dirt; all in one continuate quantity or body. But every day the body grew longer and longer, and more legs appeared, till at the length, when he saw the animal almost finished, and neer separating it self from the rest of the stick, he staied then by it, and saw it creep away in a caterpillar, leaving the stick and dirt, as much wanting of its first length, as the worms body took up. Peradventure the greatest part of such creatures maketh their way by such steps into the world. But to be able to observe their progress thus distinctly as this Gentleman did, happeneth not frequently.

7. Concerning the hatching

Therefore, to satisfie our selves herein it were well we made our remarks in some creatures that might be continually in our power

power to observe in them the course of nature every day and hour. Sir *John Heydon*, the Lieutenant of his Majesties Ordinance (that generous and knowing Gentleman; and consummate souldier both in theory and practice) was the first that instructed me how to do this, by means of a furnace so made as to imitate the warmth of a sitting hen. In which you may lay several egges to hatch; and by breaking them at several ages, you may distinctly observe every hourly mutation in them, if you please. The first will be, that on one side you shall find a great resplendent clearness in the white. After a while, a little spot of red matter like bloud, will appear in the midst of that clearness fastened to the yolk: which will have a motion of opening and shutting; so as sometimes you will see it, and straight again it will vanish from your sight; and indeed at the first it is so little, that you cannot see it, but by the motion of it; for at every pulse, as it openeth, you may see it, and immediately again, it shutteth in such sort, as it is not to be discerned. From this red speck, after a while there will stream out, a number of little (almost imperceptible) red veins. At the end of some of which, in time there will be gathered together, a knot of matter which by little and little will take the form of a head; and you will ere long begin to discern eyes and a beak in it. All this while the first red spot of bloud, groweth bigger and solider: till at the length, it becometh a fleshy substance; and by its figure, may easily be discerned to be the heart: which as yet hath no other enclosure but the substance of the egge. But by little and little the rest of the body of an animal is framed out of those red veins which stream out all about from the heart. And in process of time, that body incloseth the heart within it by the cheft, which groweth over on both sides, and in the end meeteth, and closeth it self fast together. After which this little creature soon filleth the shell, by converting into several parts of it self all the substance of the egge. And then growing weary of so straight an habitation, it breaketh prison, and cometh out, a perfectly formed chicken. of chickens, and the generation of other animals.

In like manner: in other creatures; which in Latine are called *Vivipara* (because their young ones are quick in their mothers womb) we have, by the relation of that learned and ex-

act searcher into nature, Doctor *Harvey*: that the seed of the male after his accoupling with the female, doth not remain in her womb in any sensible bulk: but (as it seemeth) evaporateth and incorporateth it self, either into the body of the womb, or rather into some more interior part, as into the seminary vessels. Which being a solid substance, much resembling the nature of the females seed, is likely to suck up, by the mediation of the females seed, the males seed incorporated with it, and by incorporation, turned as it were into a vapor: in such sort as we have formerly explicated how the body of a Scorpion or Viper draweth the poyson out of a wound. And after a certain time Doctor *Harvey* noted the space of six weeks or two moneths in Does or Hindes) these seeds distill again into the womb; and by little and little do clarifie in the midst, and a little red speck appeareth in the center of the bright clearness: as we said before of the egge.

From whence it happeneth that the deficiences, or excrescences of the parents body are often seen in their children.

8. But we should be too blame to leave our Reader without clearing that difficulty, which cannot choose but have sprung up in his thoughts, by occasion of the relations we made at the entrance into this point concerning the Cat whose kitlings were half with tails, and halt without: and the womans daughters at *Algiers*, that had as well as their mother excrescences upon their left thumbs, imitating another lesser thumb: and the like effects whatsoever they happen, which they do frequently enough.

Let him therefore remember, how we have determined that generation is made of the bloud, which being dispersed into all the parts of the body to irrigate every one of them; and to conveigh fitting spirits into them from their source or shop where they are forged; so much of it as is superabundant to the nourishing of those parts is sent back again to the heart to recover the warmth and spirits it hath lost by so long a journey. By which perpetual course of a continued circulation, it is evident that the bloud in running thus through all the parts of the body must needs receive some particular concoction or impression from every one of them. And by consequence, if there be any specifical virtue in one part which is not in another, than the bloud returning from

from thence must be endued with the virtue of that part. And the purest part of this bloud, being extracted like a quintessence out of the whole mass, is reserved in convenient receptacles or vessels, till there be use of it: and is the matter or seed, of which a new animal is to be made; in whom will appear the effect of all the specifical virtues drawn by the bloud in its iterated course, by its circular motion, through all the several parts of the parents body.

Whence it followeth, that if any part be wanting in the body whereof this seed is made, or be superabundant in it; whose virtue is not in the rest of the body, or whose superabundance is not allaid by the rest of the body; the virtue of that part cannot be in the bloud, or will be too strong in the bloud, and by consequence, it cannot be at all, or it will be too much in the seed. And the effect proceeding from the seed, that is, the young animal, will come into the world savoring of that origine; unless the mothers seed do supply or temper, what the fathers was defective or superabundant in; or contrariwise the fathers do correct the errours of the mothers.

9. The difference between the Authours opinion, and the former one.

But peradventure the Reader will tell us, that such a specifical virtue cannot be gotten by concoction of the bloud; or by any pretended impression in it; unless some little particles of the nourished part do remain in the bloud, and return back with it, according to that maxim of *Geber*, *Quid non ingreditur, non immutat:* no body can change another unless it enter into it, and mixing it self with it do become one with it. And that so in effect, by this explication we fall back into the opinion which we rejected.

To this I answer, that the difference is very great between that opinion and ours; as will appear evidently, if you observe the two following assertions of theirs. First, they affirm that a living creature is made merely by the assembling together of similar parts, which were hidden in those bodies from whence they are extracted in generation: whereas we say that bloud comming to a part to irrigate it, is by its passage through it, and some little stay in it, and by its frequent returns thither, at the length transmuted into the nature of that part: and thereby the specifical virtues of every part do grow greater, and are more diffused and extended.

Secondly, they ſay, that the embryon is actually formed in the ſeed, though in ſuch little parts as it cannot be diſcerned until each part have inlarged and increaſed it ſelf, by drawing unto it from the circumſtant bodies more ſubſtance of their own nature. But we ſay, that there is one homogeneal ſubſtance made of the bloud, which hath been in all parts of the body; and this is the ſeed: which containeth not in it, any figure of the animal from which it is refined, or of the animal into which it hath a capacity to be turned (by the addition of other ſubſtances) though it have in it the virtues of all the parts it hath often run through.

By which terms of ſpecifick virtues, I hope we have ſaid enough in ſundry places of this diſcourſe to keep men from conceiving that we do mean any ſuch unconceiveable quality, as modern philoſophers too frequently talk of, when they know not what they ſay or think, nor can give any account of. But that it is ſuch degrees and ſuch numbers, of rare and denſe parts mingled together, as conſtitute a mixed body of ſuch a temper and nature: which degrees and proportions of rare and denſe parts, and their mixture together, and incorporating into one homogeneal ſubſtance, is the effect reſulting from the operations of the exteriour agent, that cutteth, imbibeth, kneadeth, and boyleth it to ſuch a temper: which exteriour agent in this caſe, is each ſeveral part of the animals body that this juyce or bloud runneth through; and that hath a particular temper belonging to it, reſulting out of ſuch a proportion of rare and denſe parts, as we have even now ſpoken of; and can no more be witheld from communicating its temper to the bloud that firſt ſoaketh into it, and ſoon after draineth away again from it (according as other ſucceeding parts of bloud drive it on;) than a mineral chanel can chooſe but communicate its virtue unto a ſtream of water that runneth through it, and is continually grating off ſome of the ſubſtance of the mineral earth, and diſſolving it into it ſelf.

10. That the heart is imbued with the generol ſpeciſick virtues of the

But to go on with our intended diſcourſe. The ſeed thus imbued with the ſpheeifical virtues of all the ſeveral parts of the parents body, meeting in a fit receptacle the other parents ſeed; and being there duly concocted, becometh firſt a heart: which heart

heart in this tender beginning of a new animal containeth the several virtues of all the parts that afterwards will grow out of it, and be in the future animal; in the same manner as the heart of a complete animal containeth in it the specifick virtues of all the several parts of its own body, by reason of the blouds continual resorting to it in a circle from all parts of its body, and its being nourished by that juice to supply the continual consumption which the extreme heat of it must needs continually occasion in its own substance; whereby the heart becometh in a manner the compendium or abridgement of the whole animal.

whole body; whereby is confirmed the doctrine of the two former paragraphes.

Now this heart in the growing Embryon, being of the nature of fire, as on the one side it streameth out its hot parts; so on the other it sucketh oyl or fewel to nourish it self out of the adjacent moist parts; which matter aggregated unto it, being sent abroad together with the other hot parts that steam from it; both of them together do stay and settle as soon as they are out of the reach of that violent heat, that would not permit them to thicken or to rest. And there they grow into such a substance as is capable to be made of such a mixture, and are linked to the heart by some of those strings that steam out from it (for those steams do likewise harden, as we shewed more particularly when we discoursed of the tender stalks of plants) and in a word, this becometh some other part of the animal. Which thus encreaseth by order, one part being made after another, untill the whole living creature be completely framed.

So that now you see how mainly their opinion differeth from ours; since they say that there it actually in the seed a complete living creature; for what else is a living creature, but bones in such parts, nerves in such others, bloud and humours contained in such and such places, all as in a living creature? All which they say. But we make the seed to be nothing else but one mixed body, of one homogeneal nature throughout; consisting of such a multiplicity of rare and dense parts; so ballanced and proportioned in number and in magnitude of those parts; which are evenly shuffled, and alike mingled in every little parcel of the whole substance: in such sort, that the operati-

on of nature upon this ſeed, may in a long time and with a due proceſs, bring out ſuch figures, ſituation, and qualities (as fluidity, conſiſtence, drineſs, and the like) which by much mixtion and conſequent alteration, may in the end become ſuch as conſtitute a living creature of ſuch a kind. And thus it appeareth, that although other ſubſtances, and liquors, and ſteams, are from time to time mingled with the ſeed, and then with the heart, and afterwards with the other parts, as they grow on and encreaſe; yet the main virtue of the enſuing animal, is firſt in the ſeed, and afterwards in the heart.

Whence the reaſon is evident, why both defects and excreſcences do paſs ſometimes from the parents to the children; to wit, when nothing ſupplyeth the defect or correcteth the exorbitancy. Rather after this which we have ſaid, the difficulty will appear greater, in that ſuch accidents are not alwaies hereditary from the parents; but happen only now and then ſome rare times. But the ſame grounds we have laid will likewiſe ſolve this objection: for ſeeing that the heart of the animal, from whence the ſeed receiveth its proper nature (as we have declared) is impregnated with the ſpecifick virtue of each ſeveral part of the body; it cannot be doubted but that the heart will ſupply for any defect happened in any part, after it hath been imbued with that virtue, and is grown to a firmneſs, and vigorous conſiſtence with that virtue moulded, and deeply imbibed into the very ſubſtance of it. And although the heart ſhould be tinctured from its firſt origine with an undue virtue from ſome part (as it ſeemeth to have been in the mother of thoſe daughters that had two thumbs upon one hand:) yet it is not neceſſary that all the off-ſpring of that parent ſhould be formed after that model; for the other partners ſeed may be more efficacious, and predominate in the geniture, over the faulty ſeed of the other parent; and then it will ſupply for and correct the others deviation from the general rule of nature. Which ſeemeth to be the caſe of that womans male children; for in them the fathers ſeed being ſtrongeſt, all their fingers imitated the regularity of their fathers: whereas the daughters (whoſe ſex implieth that the fathers ſeed was leſs active) carried upon ſome of theirs, the reſemblance of their mothers irregularity.

And

And in confirmation of this doctrine, we daily see that the children of parents who have any of their noble parts much and long distempered, whereby there must be a great distemper in the bloud (which is made and concocted by their assistance) do seldome fail of having strong inclinations to the distempers and diseases that either of their parents were violently subject unto. Scarce any father or mothrr dyeth of the consumption of the lungs, but their children inherit that disease in some measure: the like is of the stone; the like of the gout; the like of diseases of the brain, and of sundry others; when they infested the parents with any notable eminency: For the bloud coming continually to the heart from such ill-affected parts, by its circulation through the whole body, must needs in process of time alter, and change the temper of the heart: and then both the heart giveth a tainted impression to the bloud that must be boyled into seed; and the parts themselves do communicate their debilities and distempers unto it: so that it is no wonder, if the seed do partake of such depraved qualities; since it is a maxim among Physicians, that subsequent concoctions can never amend or repair the faults of the precedent ones.

II. That the heart is the first part generated in a living creature.

Having waded thus far into this matter, and all experience agreeing that the whole animal is not formed at once: I conceive there can be no great difficulty in determining what part of it is first generated: which we have already said to be the heart; but peradventure the Reader may expect some more particular and immediate proof of it. It is evident that all the motions and changes which we have observed in the Egg and in the Doe, do proceed from heat: and it is as certain that heat is greatest in the center of it: from whence it dispersteth it self to less and less. It must then necessarily follow, that the part in which heat doth most abound, and which is the interiour fountain of it, from whence (as from a stock of their own) all the other parts derive theirs, must be formed first, and the others successively after it, according as they partake more or less of this heat; which is the Architect that mouldeth and frameth them all. Undoubtedly this can be none other but the heart: whose motion and manner of working, evidently appeares in the twinckling of the first red spot (which is the first change) in the egg, and in the first

first matter of other living creatures. Yet I do not intend to say, that the heart is perfectly framed, and completely made up with all its parts and instruments, before any other part be begun to be made: but onely the most vertuous part; and as it were the marrow of it; which serveth as a shop or a hot forge to mould spirits in: from whence they are dispersed abroad to form and nourish other parts that stand in need of them to that effect.

The shootings or little red strings that stream out from it, must surely be arteries; through which, the bloud issuing from the heart, and there made and imbued with the nature of the seed, doth run; till encountering with fit matter, it engrosseth it self into brain, liver, lights, &c. From the brain chiefly groweth the marrow, and by consequent, the bones containing it, (which seem to be originally, but the outward part of the marrow, baked and hardened into a strong crust by the great heat that is kept in:) as also the sinewes; which are the next principal bodies of strength, after the bones. The marrow being very hot drieth the bones; and yet with its actual moysture it humecteth and nourisheth them too, in some sort. The spirits that are sent from the brain do the like to the sinewes. And lastly, the arteries and veines by their bloud do cherish and bedew the flesh. And thus the whole living creature is begun, framed, and made up.

CHAP. XXV.

How a plant or Animal cometh to that figure it hath.

1 That the figure of an Animal is produced by ordinary second causes, as well as any other corporeal effect.

BUt before we go any farther, and search into the operations of this animal, a wonderfull effect calleth our consideration unto it: which is, how a plant or animal cometh by the figure it hath, both in the whole and in every part of it? *Aristotle*, after he had beaten his thoughts as far as he could upon this question, pronounced that this effect could not possibly be wrought by the virtue of the first qualities; but that it sprung from a more-divine origine. And most of the contemplators of Nature since him do seem to agree, that no cause can be rendered of it; but that it is to be referred meerly to the specifical nature

nature of the thing. Neither do we intend to derogate from either of these causes; since that both divine providence is eminently shown in contriving all circumstances necessary for this work; and likewise, the first temperament that is in the seed must needs be the principal immediate cause of this admirable effect.

This latter then being supposed; our labour and endeavour will be, to unfold (as far as so weak and dim eyes can reach) the excellency and exactness of Gods providence, which cannot be enough adored, when it is reflected upon, and marked in the apt laying of adequate causes to produce such a figure out of such a mixture first layed. From them so artificially ranged, we shall see this miracle of nature to proceed; and not from an immediate working of God or nature without convenient and ordinary instruments to mediate and effect this configuration, through the force and virtue of their own particular natures. Such a necessity to interest the chief workman at every turn, in particular effects, would argue him of want of skill and providence, in the first laying of the foundations of his designed machin: he were an improvident clock-maker, that should have cast his work so, as when it were wound up and going, it would require the masters hand at every houre to make the hammer strike upon the bell. Let us not then too familiarly, and irreverently ingage the Almighty Architect his immediate handy-work in every particular effect of nature; *Tali non est dignus vindice nodus.*

2. That the several figures of bodies proceed from a defect in one of the three dimensions, caused by the concurrence of accidental causes.

But let us take principles within our own kenning; and consider how a body hath of its own nature three dimensions, (as Mathematicians use to demonstrate:) and that the variety which we see of figures in bodies proceedeth out of the defect of some of these dimensions in proportion to the rest. As for example, that a thing be in the form of a square tablet; is, for that the cause which gave it length and breadth, could not also give it thickness in the same proportion: for had it been able to give profundity as well as the other two, it had made a cube instead of a tablet. In like manner, the form of a lamine, or very long square is occasioned by some accident which hindereth the cause from giving breadth and thickness proportiona-

tionable to the length. And ſo, other figures are made, by reaſon that their cauſes are ſome waies bound to give more of ſome dimenſion to one part than to another.

As for example, when water falleth out of the skie, it hath all the little corners or extancies of its body grated off by the air as it rolleth and tumbleth down in it, ſo that it becometh round; and continueth in that form, until that ſetling upon ſome flat body, as graſs, or a leaf, it receiveth a little plainneſs, to the proportion of its weight maſtering the continuity of it. And therefore, if the drop be great upon that plain body, it ſeemeth to be half a ſphere, or ſome leſs portion of one: but if it be a little drop then the flat part of it (which is that next unto the graſs) is very litle and undiſcernable, becauſe it hath not weight enough to preſs it much and ſpread it abroad upon the graſs; and ſo the whole ſeemeth in a manner to be a ſphere: but if the extern cauſes had preſſed upon this drop, onely broadwaies and thickwaies (as when a turner maketh a round pillar of a ſquare one) then it would have proved a cylinder, nothing working upon it to grate off any of its length, but onely the corners of the breadth and thickneſs of it.

And thus you ſee, how the fundamental figures (upon which all the reſt are grounded) are contrived by nature; not by the work of any particular Agent that immediately imprinteth a determinate figure into a particular body, as though it wrought it there at once, according to a foreconceived deſigne or intelligent aim of producing ſuch a figure in ſuch a body: but by the concurrence of ſeveral accidental cauſes, that do all of them joyn in bringing the body they file and work upon, into ſuch a ſhape.

Onely we had like to have forgotten the reaſon and cauſe of the concave figure in ſome parts of plants: which in the ordinary courſe of nature we ſhall find to grow from hence, that a round outſide being filled with ſome liquour which maketh it grow higher and higher, it happeneth that the ſucceeding cauſes do contract this liquour, and do harden the outſide: and then of neceſſity there muſt be a hollow cylinder remaining in lieu of the juyce which before did fill it. As we ſee every day in corn, and

and in reeds, and in canes, and in the stalks of many herbs: which whilest they are tender and in their first growth, are full of juice, and become afterwards hollow and dry.

But because this discourse, may peradventure seem too much in common: it will not be amiss to apply it to some particulars that seem very strange. And first, let us examine how the rocking of concrete juices (which seemeth to be such an admirable mystery of nature) is performed. Allom falleth down in lumps, saltpeter in long icicles, and common salt in squares; and this, not once, or sometimes now and than; but alwaies constantly in the same order. 3. The former doctrine is confirmed by several instances.

The reason of these effects will easily be deduced out of what we have said, for if all three be dissolved in the same water, allom being the grossest falleth first and fastest and being of an unctious nature, the first part which falleth doth not harden till the second cometh to it; whereby this second sticketh to the first and crusheth it down, and this is served in the same manner by the third; and so goeth on, one part squeezing another, till what is undermost grow hard enough to resist the weight of new falling parts; or rather till no more do fall, but the liquor they were dissolved in, is delivered of them all, and than they harden in that figure they were compressed into.

As for salt, which descendeth in the second place: that swimmeth first upon the water; and there getteth its figure, which must be equally long and broad, because the water is indifferent to those two positions; but its thickness is not equal to its other two dimensions, by reason that before it can attain to that thickness, it groweth too heavy to swimme any longer; and after it is encreased to a certain bulk, the weight of it carrieth it down to the bottom of the water, and consequently, it can encrease no more: for it encreaseth by the joyning of little parts unto it as it swimmeth on the top of the water.

The saltpeter falleth last: which being more difficult to be figured than the other two, because it is more dry than either of them (as consisting chiefly of earthy and of fiery parts,) is not equally encreased, neither in all three, nor in two dimensions, but hath its length exceeding both its breadth and thickness: and

and its lightneſs maketh it laſt laſt, becauſe it requireth leaſt water to ſuſtain it.

To give the cauſes of the figures of divers mixts, and particularly of ſome precious ſtones, (which ſeem to be caſt by nature in exacteſt moulds) would oblige us to enter into the particular manner of their generation: which were exceeding hard, if not impoſſible, for us to do, by reaſon that Authours have not left us the circumſtances upon which we might ground our judgement concerning them, ſo particularly deſcribed as were neceſſary; nor our ſelves have met with the commodity of making ſuch experiences, and of ſearching ſo into their beds as were requiſite, to determine ſolidly the reaſons of them. And indeed I conceive that oftentimes the relations which others have recorded of their generation, would rather miſlead than aſſiſt us: ſince it is very familiar in many men, to magnifie the exactneſs of nature in framing effects they fanſie to themſelves, when to make their wonder appear more juſt; they will not fail to ſet off their ſtory, with all advantagious circumſtances, and help out what wanteth a little or cometh but neer the mark.

4. The ſame doctrine applied to Plants.

But to come cloſer to our purpoſe; that is, to the figures of living things: we ſee that roots in the earth are all of them figured almoſt in the ſame faſhion: for the heat reſiding in the middeſt of them, puſheth every way, and thereupon, ſome of them do become round, but others more long than round, according to the temper of the ground, or to the ſeaſon of the year, or to the weather that happeneth: and this, not onely in divers kindes of roots, but even in ſeveral of the ſame kind. That part of the plant which mounteth upwards is for the moſt part round and long; the cauſe whereof is evident, for the juice which is in the middle of it working upwards (becauſe the hardneſs of the bark will not let it out at the ſides) and coming in more and more abundance (for the reaſons we have above delivered) encreaſeth that part equally every way but upwards; and therefore, it muſt be equally thick and broad, and conſequently round: but the length will exceed either of the other dimenſions; becauſe the juice is driven up with a greater force and in more quantity than it is to the ſides. Yet the

the broadneſſe and thickneſſe are not ſo exactly uniform, but that they exceed a little more at the bottom than at the top; which is occaſioned partly by the contracting of the juice into a narrower circuit the farther it is from the ſource; and partly by reaſon of the branches; which ſhooting forth, do conveigh away a great part of the juice from the main ſtock.

5. The ſame doctrine declared in leafs of trees

Now if we conſider the matter well; we ſhall finde, that what is done in the whole tree, the very ſame is likewiſe done in every little leaf of it: for a leaf conſiſteth of little branches ſhooting out from one greater branch, which is in the middle: and again, other leſſer branches are derived from thoſe ſecond branches: and ſo ſtill leſſer and leſſer, till they weave themſelves into a cloſe work, as thick as that which we ſee women uſe to fill up with ſilk or crewel, when in tent-work they embroader leafs or flowers upon canvas: and this again, is covered and as it were glewed over, by the humour which ſticking to theſe little thrids, ſtoppeth up every little vacuity, and by the air is hardned into ſuch a skin as we ſee a leaf conſiſteth of.

And thus it appeareth how an account may be given of the figure of the leafs, as well as of the figure of the main body of the whole tree: the little branches of the leaf, being proportionate in figure to the branches of the tree it ſelf (ſo that each leaf ſeemeth to be the tree in little;) and the figure of the leaf depending of the courſe of theſe little branches, ſo that if the greateſt branch of the tree be much longer than the others, the leaf will be a long one: but if the leſſer branches ſpread broadwaies, the leaf will likewiſe be a broad one; ſo far, as even to be notched at the outſides, round about it, in great or little notches, according to the proportion of the trees branches. Theſe leafs, when they firſt break out, are foulded inwards, in ſuch ſort as the ſmalneſs and roundneſs of the paſſage in the wood through which they iſſue, conſtraineth them to be: where nevertheleſs the drineſs of their parts keep them aſunder, ſo that one leaf doth not incorporate it ſelf with another: but as ſoon as they feel the heat of the Sun (after they are broken out into liberty) their tender branches by little and little grow

grow more straight: the concave parts of them drawing more towards the Sun, because he extracteth and sucketh their moisture from their hinder parts into their former, that are more exposed to his beams; and thereby the hinder parts are contracted and grow shorter, and those before grow longer. Which if it be in excess, maketh the leaf become crooked the contrary way, as we see in divers flowers, and in sundry leafs during the Summers heat: witness, the Ivie, Roses full blown, Tulips, and all flowers in form of bells: and indeed all kindes of flowers whatsoever, when the Sun hath wrought upon them to that degree we speak of, and that their joyning to their stalk, and the next parts thereunto, allow them scope to obey the impulse of those outward causes. And when any do vary from this rule, we shall as plainly see other manifest causes producing those different effects, as now we do these working in this manner.

As for fruits though we see that when they grow at liberty upon the tree, they seem to have a particular figure allotted them by nature: yet in truth, it is the ordered series of natural causes and not an intrinsical formative virtue which breedeth this effect, as is evident by the great power which art hath to change their figures at pleasure: whereof you may see examples enough in *Campanella*, and every curious gardner can furnish you with store.

6. The same applied to the bodies of Animals.

Out of these, and such like principles a man that would make it his study with less trouble or tediousness, than that patient contemplator of one of Natures little works (the Bees) whom we mentioned a while agone, might without all doubt trace the causes in the growing of an Embryon, till he discovered the reason of every bones figure; of every notable hole or passage that is in them: of the Ligaments by which they are tied together: of the membranes that cover them, and of all the other parts of the body. How, out of a first masse, that was soft, and had no such parts distinguishable in it, every one of them came to be formed, by contracting that masse: in one place, by dilating it in another, by moistning it in a third, by drying it here, hardening it there.

Vt

——Ut his exordia primis,
Omnia, & ipse tener hominis concreverit orbis.

till in the end this admirable machine and frame of mans body, was compoſed and faſhioned up by ſuch little, and almoſt inſenſible ſteps and degrees. Which when it is looked upon in bulk, and entirely formed, ſeemeth impoſſible to have been made, and to have ſprung meerly out of theſe principles, without an intelligence immediately working and moulding it at every turn, from the beginning to the end.

But withall, we cannot chooſe but break out into an extaſie of admiration and hymns of praiſe (as great *Galen* did upon the like occaſion) when we reverently conſider the infinite wiſdom, and deep far-looking providence of the all-ſeeing Creator and orderer of the world, in ſo punctually adapting ſuch a multitude and ſwarm of cauſes to produce by ſo long a progreſs ſo wonderfull an effect: in the whole courſe of which, if any one, the very leaſt of them all, went never ſo little awry, the whole fabrick would be diſcompoſed and changed from the nature it is deſigned unto.

Out of our ſhort ſurvey of which (anſwerable to our weak talents, and ſlender experience) I perſwade my ſelf it appeareth evident enough, that to effect this work of generation, there needeth not be ſuppoſed a forming virtue, or *Vis formatrix* of an unknown power and operation, as thoſe that conſider things ſuddenly, and but in groſs, do uſe to put. Yet in diſcourſe, for conveniency and ſhortneſs of expreſſion, we ſhall not quite baniſh that tearm from all commerce with us; ſo that what we mean by it be rightly underſtood, which is the complex aſſemblement, or chain of all the cauſes, that concur to produce this effect, as they are ſet on foot to this end by the great Architect and Moderator of them, God Almighty, whoſe inſtrument Nature is: that is, the ſame thing, or rather the ſame things ſo ordered as we have declared, but expreſſed and compriſed under another name.

7. In what ſenſe the Authour doth admit of *Vis formatrix.*

CHAP. XXVI.

How motion beginneth in living creatures. And of the motion of the heart; circulation of the blood; Nutrition, Augmentation, and corruption or death.

1. From whence doth proceed the primary motion and growth in plants.

BUt we must not take our leave of this subject, until we have examined, how motion beginneth in living things; as well plants as sensitive creatures. We can readily pitch upon the part we are to make our observation in, for retriving the origine of this primary motion: for having concluded, That the roots of plants, and the hearts of animals, are the parts of them which are first made, and from which the forming virtue is derived to all the rest, it were unreasonable to seek for their first motion any where else.

But in what manner, and by what means, doth it begin there? for roots, the difficulty is not great: for the moisture of the earth pressing upon the seed, and soaking into it; the hot parts of it which were imprisoned in cold and dry ones, are thereby stirred up and set on work: then they mingling themselves with that moisture, do ferment and distend the whole seed; till making it open, and break the skin, more juyce cometh in: which incorporating it self with the heat, those hot and now moist parts will not be contained in so narrow a room as at the first; but strugling to get out on all sides, and striving to enlarge themselves, they thrust forth little parts: which, if they stay in the earth, do grow white, and make the root; but those which ascend, and make their way into the air, being less compressed, and more full of heat and moisture, do turn green: and as fast as they grow up, new moisture coming to the root, is sent up through the pores of it: and this faileth not, until the heat of the root it self doth fail. For it being the nature of heat to rarifie and elevate, there must of necessity be caused in the earth a kind of sucking in of moisture into the root from the next parts unto it to fill those capacities which the dilating heat hath made, that

that else would be empty, and to supply the rooms of those which the heat continually sendeth upwards: for the moisture of the root hath a continuity with that in the earth, and therefore, they adhere together (as in a pump, or rather as in filtration, and do follow one another when any of them are in motion) and still the next must needs come in, and fill the room, where is findeth an empty space immediate to it. The like of which happeneth to the air when we breathe: for our lungs being like a bladder, when we open them, the air must needs come in, to fill that capacity which else would be empty: and when we shut them again, as in a pair of bellows, we put it out.

2. *Monsieur des Cartes*, his opinion touching the motion of the heart.

This may suffice, concerning the primary motion of roots: but in that of the heart, we shall finde the matter not altogether so plain. *Monsieur Des Cartes* following herein the steps of the learned and ingenuous Doctor *Harvey*, who hath invented and teacheth that curious and excellent Doctrine of the circulation of the blood; (as indeed, what secret of nature can be hidden from so sharp a wit, when he applieth himself to penetrate into the bottom of it:) explicateth the matter much after this sort. That the heart, within, in the substance of it, is like a hollow cavern, in whose bottom, were an hot stone, on which should drop as much liquor as the fiery stone could blow into smoke; and this smoke or steam should be more than the cave could contain, wherefore it must break out; which to do, it presseth on all sides to get an issue or door to let it out: it findeth of two sorts, but onely one kind of them will serve it for this purpose; for the one sort of these doors, openeth inwards, the other outwards: which is the cause that the more it striveth to get out, the faster it shutteth the doors of the first kind; but by the same means, it beateth back the other doors, and so getteth out.

Now when it is gone quite out of this cavern, and consequently leaveth it to its natural disposition, whereas before it violently stretched it out; and by doing so, kept close the doors that open inwards: then all the parts of it begin to slacken, and those doores give way unto new liquour to drop in anew; which the heat in the bottom of the heart, rarifieth again

into smoke as before. And thus he conceiveth the motion of the heart to be made, taking the substance of it to be (as I may say) like unto limber leather, which upon the filling of it with blood and steam, openeth and dilateth it self: and at the going of it out, it shrinketh together like a bladder.

3. The former opinion rejected

But I doubt, this explication will not go through the difficulty: for first, both *Galen* and Doctor *Harvey* do shew, that as soon as the blood is come into the heart, it contracteth it self: which agreeth not with *Monsieur des Cartes* his supposition: for in his doctrine, there appeareth no cause why it should contract it self when it is full: but contrariwise, it should go on dilating it self, until enough of the blood which dropped into the heart, were converted into steam, to force the doors open; that so, it may gain an issue thence, and a passage into the body.

Next, *Monsieur de Cartes* supposeth that the substance of the heart is like a bladder, which hath no motion of it self, but openeth and shutteth, according as what is within it stretcheth it out, or permitteth it to shrink and fall together again. Whereas Doctor *Harvey* proveth, That when it is full, it compresseth it self by a quick and strong motion, to expell that which is in it: and that when it is empty, it returneth to its natural dilatation, figure and situation, by the ceasing of that agents working, which caused its motion. Whereby it appeareth to be of such a fibrous substance, as hath a proper motion of its own.

Thirdly, I see not how this motion can be proportional: for the heart must needs open and be dilated, much faster than it can be shut and shrink together: there being no cause put to shut it, and to bring it to its utmost period of shrinking, other than the going out of the vapour, whereby it becometh empty: which vapour not being forced by any thing, but by its own inclination, it may peradventure at the first, when there is abundance of it, swell and stretch the heart forcibly out; but after the first impulse and breach of some part of it out of the cavern that enclosed it, there is nothing to drive out the rest, which must therefore steam very leisurely out.

Fourthly,

Fourthly, what should hinder the bloud from coming in before the heart be quite empty and shrunk to its lowest pitch? For as soon as the vapour yieldeth within, new bloud may fall in from without, and so keep the heart continually dilated, without ever suffering it to be perfectly and completely shut.

Fifthly, the heart of a viper layed upon a plate in a warm place will beat four and twenty howers, and much longer, if it be carefully taken out of its body, and the weather be warm and moyst: and it is clear, that this is without succession of bloud to cause the pulses of it. Likewise, the severed members of living creatures will stirr for some time after they are parted from their bodies: and in them, we can suspect no such cause of motion.

Sixthly, in *Monsieur des Cartes* his opinion, the heart should be hardest when it is fullest; and the eruption of the steam out of it, should be strongest at the beginning; whereas experience sheweth, that it is softest when it is at the point of being full, and hardest when it is at the point of being empty; and the motion strongest towards the end.

Seventhly, in *Monsieur des Cartes* his way, there is no agent or force strong enough to make bloud gush out of the heart: for if it be the steam onely that openeth the doores, nothing but it will go out; and the bloud will still remain behind, since it lieth lower than the steam, and farther from the issue that letteth it out: but doctor *Harvey* findeth by experience (and teacheth how to make this experience) that when a wound is made in the heart, bloud will gush out by spurts at every shooting of the heart.

And lastly, if *Monsieur des Cartes* his supposition were true, the arteries would receive nothing but steams; whereas it is evident that the chief filler of them is bloud.

4. The Authours opinion concerning the motion of the heart.

Therefore we must enquire after another cause of this primary motion of a sensitive creature, in the beatings of its heart. Wherein we shall not be obliged to look far: for seeing we find this motion and these pulsations in the heart when it is separated from the body, we may boldly and safely conclude, that it must of necessity be caused by something that is

within the heart it self. And what can that be else, but heat or spirits imprisoned in a tough viscuous bloud; which it cannot so presently break through to get out; and yet can stir within it and lift it up.

The like of which motion may be observed, in the heaving up, and sinking down again of loose mould thrown into a pit, into which much ordure hath been emptied. The same cause of heat in the earth, maketh mountains and sands to be cast up in the very sea: so, in frying, when the pan is full of meat, the bubbles rise and fall at the edges: treacle and such strong compounded substances, whiles they ferment, do lift themselves up and sink down again, after the same manner as the vipers heart doth: as also do the bubbles of barm, and must of wine, and short ends of lute strings baked in a juicy pie, will at the opening of it move in such sort, as they who are ignorant of the feat will think there are magots in it: and a hot loaf, in which quicksilver is enclosed, will not onely move thus, but will also leap about, and skip from one place to another, like the head or limb of an animal (very full of spirits) newly cut off from its whole body.

And that this is the true cause of the hearts motion, appeareth evidently. First, because this virtue of moving is in every part of the heart, as you will plainly see if you cut into several pieces a heart, that conserveth its motion long after it is out of the animals belly: for every piece will move; as Doctor *Harvey* assureth us by experience, and I my self have often seen, upon occasion of making the great antidote, in which vipers hearts is a principal ingredient. Secondly, the same is seen in the auricles and the rest of the heart; whose motions are several; though so near together, that they can hardly be distinguished. Thirdly, Doctor *Harvey* seemeth to affirm that the bloud which is in the ears of the heart, hath such a motion of it self, precedent to the motion of the ears it is in: and that this virtue remaineth in it for a little space after the ears are dead. Fourthly, in touching a heart which had newly left moving, with his finger wetted with warm spittle, it began to move again, as testifing that heat and moisture made this motion: Fifthly, if you touch the vipers heart over with vineger

with'

with spirit of wine, with sharp white wine, or with any piercing liquour; it presently dyeth: for the acuteness of such substances pierceth through the viscuous bloud, and maketh way for the heat to get out.

But this first mover of an animal, must have something from without to stir it up; else, the heat would lie in it, as if it were dead; and in time would become absolutely so. In egges, you see this exteriour mover, is the warmth of the hen hatching them. And in Embryons, it is the warmth of the mothers womb. But when in either of them, the heart is completely formed, and is enclosed in the breast, much heat is likewise enclosed there, in all the parts near about the heart; partly made by the heart it self, and partly caused by the outward heat, which helped also to make that in the heart; and then although the warmth of the hen or of the mothers womb, do forsake the heart; yet this stirreth up the native heat within the heart, and keepeth it in motion, and maketh it feed still upon new fewel, as fast as that which it worketh upon decayeth.

5. The motion of the heart dependeth originally of its fibres irrigated by bloud.

But to express more particularaly how this motion is effected; we are to note, that the heart hath in the ventricles of it three sorts of fibers; the first go long waies or are straight ones, on the sides of the ventricles from the thick basis of the heart, towards the little tip or cone of it: the second, go cross or roundwayes about the vintricles within the heart: and the third, are transversal or thwart ones. Next, we are to remember, that the heart is fixed to the body by its base; and hangeth loose at the cone. Now then, the fibres being of the nature of such things as will swell and grow thicker by being moistned, and consequently shrink up in length and grow shorter in proportion to their swelling thicker (as you may observe in a loose-wrought hempen rope) it must of necessity follow, that when the bloud falleth into the heart (which is of a kind of spungie substance) the fibres being therewith moistned, they will presently swell in roundness and shrink in length.

Next, we are to note, that there is a double motion in the heart, the one of opening, which is called, Diastole; the other of shutting, which is termed Systole. And although Doctor *Harvey* seemeth to allow the opening of the heart to be no motion;

but rather a relenting from motion; nevertheless (me thinketh) it is manifest, that it is not onely a compleat motion; but in a manner the greater motion of the two, though indeed the less sensible; because it is performed by little and little; for in it the heart is drawn by violence from its natural position; which must be (as it is of all heavy things) that by which it approcheth most to the center of gravity; and such a position we see it gaineth by the shutting of it.

Now to declare how both these motions are effected, we are to consider how at the end of the systole the heart is voided and cleansed of all the bloud that was in it; whence it followeth, that the weight of the bloud which is in the auricles, pressing upon the *valvulas* or doores that open inwards, maketh its way by little and little into the ventricles of the heart, where it must necessarily sweell the fibers; and they being swelled must needs draw the heart into a roundish and capacious figure, which the more it is done, the more bloud cometh in, and with greater violence. The following effect of which must be, that the weight of the bloud joyned to the weight of the heart it self, and particularly of the *conus* or tip (which is more solid and heavie in proportion to its quantiy, than the rest of the heart) must necessarily set the heart into the natural motion of descending according to its gravity: the which consequently, is performed by a lively jerck, whereby it cometh to pass that the tip of our heart doth as it were spring up towards our breast, and the bloud is spurted out by other *valvulæ* (that open outwards) which are aptly disposed to be opened upon such a motion, and do convey it to the arteries.

In the course of which motion, we may note how the figure of our heart contributeth to its springing up towards our breast; for the line of distance which is between the basis & the tip being longer on that side which is towards the back, than on the other which is towards the breast, it must happen that when the heart shutteth and straightneth it self, and thereby extendeth it self to its length, the tip will butt out forwards towards the breast.

6. An objection answered against the former doctrine,

Against this doctrine of the motion, and of the systole and diastole of the heart, it may be objected, that beasts hearts do not hang like a mans heart, straight downwards; but rather horizontally; and therefore this motion of gravity cannot have

place

place in them: nevertheless, we are sure they beat, and do open and shut regularly. Besides, if there were no other cause but this of gravity for the motion of a mans heart, it would follow that one who were set upon his head, or hung by his heels, could not have the motion of his heart: which posture nevertheless, we see men remain in for a pretty while, without any extreme prejudice.

But these difficulties are easily answered; for whether beasts hearts do lie directly horizontally, or whether the basis be fastened somewhat higher than the tip reacheth, and so maketh their heart hang inclining downwards; still the motion of gravity hath its effect in them. As we may perceive in the heart of a viper being upon a plate, and in any other thing that of it self swelleth up, and straight again sinketh down: in which we cannot doubt, but that the gravity fighting against the heat, maketh the elevated parts to fall, as the heat maketh them rise.

And as for the latter; it is evident that men cannot stay long in that posture without violent accidents; and in any little while we see that the bloud cometh into their face and other parts which naturally are situated higher; but by this position become lower than the heart: and much time is not required, to have them quite disordered and suffocated; the bloud passing through the heart with too much quickness, and not receiving due concoction there; and falling thence in too great abundance into places that cannot with conveniency entertain it.

But you will insist, and ask, whether in that posture the heart doth move or no, and how? And to speak by guess in a thing I have not yet made experiences enough to be throughly informed in; I conceive without any great scruple that it doth move. And that it happeneth thus; that the heart hanging somewhat loose, must needs tumble over, and the tip of it lean downwards some way or other; and so lie in part like the heart of a beast; though not so conveniently accommodated: and then the heat which maketh the viscuous bloud that is in the substance of the heart to ferment, will not fail of raising it up: whereupon the weight of that side of the heart that is lifted up, will presently press it down again. And thus, by the alternative operations of these causes,

causes the heart will be made to open and shut it self, as much as is necessary for admitting and thrusting out that little and disorderly coming bloud, which maketh its course through it, for that little space wherein the man continueth in that position.

7. The circulation of the bloud and other effects that follow the motion of the heart.

Now from these effects wrought in the heart by the moistening of the fibres, two other effects do proceed: the one is, that the bloud is pushed out of every corner of the heart with an impetuousness or velocity. The other is, that by this motion the spirits which are in the ventricles of the heart, and in the bloud, that is even then heated there, are more and deeper pressed into the substance of the heart, so that you see the heare imbibeth fresh vigour, and is strengthened with new spirits, whiles it seemeth to reject that which should strengthen it.

Again, two other effects follow this violent ejection of the bloud out of the heart. The one is, that for the present the heart is entirely cleansed of all remainders of blond, none being permitted to fall back to annoy it. The other is, that the heart finding it self dry, the fibres do relent presently into their natural position and extension, and the valvulæ that open inwards, fall flat to the sides of the ventricles, and consequently new bloud droppeth in So that in conclusion, we see the motion of the heart dependeth originally of its fibres irrigated by the bloud, and not from the force of the vapour, as *Monsieur des Cartes* supposeth.

This motion of the heart driveth the bloud (which is warmed and spiritualized, by being boyled in this furnace) through due passages into the arteries, which from them runneth into the veins; and is a main cause of making and nourishing other parts; as the liver, the lungs, the brains, and whatsoever else dependeth of those veins and arteries through which the bloud goeth. Which being ever freshly heated, and receceiving the tincture of the hearts nature, by passing through the heart, whereso evet it stayeth and curdleth, it groweth into a substance of a nature conformable to the heart, though every one of such substances be of exceeding different conditions in themselves, the very grossest excrements not being excluded from some participation of that nature.

But

But if you desire to follow the bloud all along every step in its progress from the heart round about the body, till it return back again to its center, D. ctor *Harvey* who most acutely teacheth this doctrine, must be your guide. He will shew you how it issueth from the heart by the arteries, from whence it goeth out warming the flesh, until it arrive to some of the extremities of the body: and by then it is grown so cool (by long absence from the fountain of its heat, and by evaporating its own stock of spirits, without any new supply) that it hath need of being warmed anew; it findeth it self returned back again to the heart, and is there heated again, which return is made by the veins, as its going forwards is performed onely by the arteries.

And were it not for this continnal circulation of the bloud, and this new heating it in its proper caldron, the heart; it could not be avoided but that the extreme parts of the body would soon grow cold and die. For flesh being of it self of a cold nature (as is apparent in dead flesh) and being kept warm, merely be the bloud that bedeweth it; and the bloud likewise being of a nature that soon groweth cold and congealeth, unless it be preserved in due temper by actual heat working upon it: how can we imagine that they two singly, without any other assistance, should keep one another warm (especially in those parts that are far distant from the heart) by onely being together? Surely we must allow the bloud, (which is a substance fit for motion) to have recourse back to the heart, where onely it can be supplyed with new heat and spirits) and from thence be driven out again by it pulses or strokes, which are his shuttings. And as fast as it flieth out, (like a reeking thick steam, which riseth from perfumed water falling upon a heated pan) that which is next before it must flie yet farther on, to make way for it; and new arterial bloud still issuing forth at every pulse, it must still drive on what issued thence the last precedent pulse, and that part must press on what is next before it. And thus it fareth with the whole mass of bloud, which having no other course but in the body, it must at length run round, aed by new vessels (which are the veins) return back unto the place from whence it issued first: and by that time it cometh thither, it is grown cool and thick, and needeth a vigorous restauration of

spirits

spirits and a new rarifying; that then it may warm the fish it passeth again through: without which it would suddenly grow stone cold, as is manifest if by tying or cutting the arteries, you intercept the bloud, which is to nourish any part: for then that part groweth presently cold and benummed.

8. Of Nutrition.

But referring the particulars of this doctrine unto Doctor *Harvey* (who hath both invented and perfected it) our task in hand calleth upon us to declare in common the residue of motions that all living creatures agree in. How generation is performed we have determined in the past discourse. Our next consideration then ought to be of Nutrition and Augmentatioo. Between which there is very little difference in the nature of their action, and the difference of their names is grounded moe upon the different result in the period of them, than upon the thing it self; as will by and by appear. Thus then is the progress of this matter: as soon as a living creature is formed, it endeavoreth straight to augment it self; and imployeth it self onely about that; the parts of it being yet too young and tender to perform the other functions which nature hath produced them for. That is to say; the living creature, at its first production, is in such a state and condition as it is able to do nothing else, but (by means of the great heat that is in it) to turn into its own substance the abundance of moisture that overfloweth it.

They who are curious in this matter, do tell us that the performance of this work consisteth in five actions; which they call Attraction, Adhesion, Concoction, Assimilation, and Unition. The nature of attraction we have already declared when we explicated how the heart and the root sendeth juyce into the other parts of the animal or plant: for they abounding in themselves with inward heat, and besides that, much other circumstant heat working likewise upon them; it cannot be otherwise but that they must needs suck and draw into them, the moysture that is about them.

As for adhesion, the nature of that is likewise explicated, when we shewed how such parts as are moist, but especially aereal or oily ones (such as are made by the operation of a soft and continual heat) are catching, and do easily stick unto any body

body they happen to touch: and how a little part of moiſture between two dry parts, joyneth them together. Upon which occaſion, it is to be noted, that parts of the ſame kind do joyn beſt together: and therefore the powder of glaſs is uſed to ciment broken glaſs withall (as we have touched ſomewhere above:) and the powder of marble to ciment marble with; and ſo of other bodies: in like manner, Alchymiſts find no better expedient to extract a ſmall proportion of ſilver mixed with a great one of gold, than to put more ſilver to it: nor any more effectual way to get out the heart, or tincture, or ſpirits of any thing they diſtill or make an extract of, than to infuſe its own flegme upon it, and to water it with that. Now whether the reaſon of this be, that continuity, becauſe it is an unity, muſt be firmeſt between parts that are moſt conformable to one another, and conſequently are moſt one among themſelves; or whether it be for ſome other hidden cauſe, belongeth not to this place to diſcourſe: but in fine ſo it is. And the adhefion is ſtrongeſt of ſuch parts as are moſt conformable to that which needeth encreaſe and nouriſhment; and that is made up by the other three actions.

Of which, concoction is nothing elſe but a thickning of that juyce which already ſticketh to any part of the animals body, by the good digeſtion that heat maketh in it. And aſſimilation is the effect of concoction: for this juyce being uſed in the ſame manner, as the firſt juyce was that made the part whereunto this is to be joyned; it cannot chooſe but become like unto it in ſubſtance: And then, there being no other ſubſtance between, it is of it ſelf united unto it without any farther help.

Hitherto this action belongeth to nutrition. But if on the one ſide, the heat and ſpirituality of the bloud; and on the other ſide, the due temper and diſpoſition of the part be ſuch, as the blood is greedily ſucked into the part, which thereby ſwelleth to make room for it, and will not let it go away, but turneth it into a like ſubſtance as it ſelf is; and in greater quantity than what is conſumed and decayeth continually by tranſpiration; then this action is called likewiſe augmentation. Which *Galen* explicateth by a ſport the boyes of *Ionia* uſed; who were accuſtomed to fill a bladder with wind; and when they could force no more into it, they would rub the bladder, and after rubbing of it, they found

9. Of Augmentation.

found it capable of receiving new breath; and ſo they would proceed on, until their bladder were as full as by uſe they knew it could be made. Now (ſaith he) nature doth the like, by filling our fleſh and other parts with blood; that is to ſay, it ſtretcheth the fibers: but ſhe hath over and above a power which the boys had not; namely, to make the fibers as ſtrong after they are ſtretched to their utmoſt extenſion, as they were before they were extended: whence it happeneth, that ſhe can extend them again as well as at the firſt; and this without end, as far as concerneth that part.

The reaſon whereof is, becauſe ſhe extendeth them by means of a liquor which is of the ſame nature, as that whereof they were made at the firſt: and from whence it followeth, that by concoction that liquor ſettleth in the parts of the fibers which have moſt need; and ſo maketh thoſe parts as great in the length they are extended unto, as they were in their ſhortneſs before they were drawn out. Whereby the whole part of the animal, wherein this happeneth, groweth greater: and the like being done in every part, as well as in any one ſingle one, the whole animal becometh bigger, and is in ſuch ſort augmented.

10. Of death and ſickneſs.

Out of all which diſcourſe, we may collect, that in the eſſential compoſition of living creatures, there may peradventure be a phyſical poſſibility for them to continue alwaies without decay; and ſo become immortal, even in their bodies, if all hurtfull accidents coming from without might be prevented. For ſeeing that a man, beſides the encreaſe which he maketh of himſelf, can alſo impart unto his children a virtue, by which they are able to do the like, and to give again unto theirs as much as they received from their fathers: it is clear, that what maketh him die, is no more the want of any radical power in him, to encreaſe or nouriſh himſelf, than in fire, it is the want of power to burn, which maketh it go out. But it muſt be ſome accidental want; which *Galen* attributeth chiefly to the drineſs of our bones, and ſinews, &c. as you may in him ſee more at large; for drineſs with denſity alloweth not eaſie admittance unto moiſture: and therefore it cauſeth the heat which is in the dry body, either to evaporate, or to be extinguiſhed: and want of heat is that from whence the failing of life proceedeth

eth: which he thinketh cannot be prevented by any art or industry.

And herein God hath expressed his great mercy and goodness towards us: for seeing that by the corruption of our own nature, we are so immersed in flesh and blood, as we should for ever delight to wallow in their mire, without raising our thoughts at any time above that low and brutal condition: he hath engaged us by a happy necessity, to think of, and to provide for a nobler, and far more excellent state of living, that will never change, or end.

In pursuance of which inevitable ordinance, man (as if he were grown weary and out of love with this life, and scorned any term in his farm here, since he cannot purchase the fee-simple of it) hasteneth on his death by his unwary and rash use of meats, which poyson his blood: and then his infected blood passing through his whole body, must needs in like manner taint it all at once. For the redress of which mischief, the assistance of physick is made use of: and that passing likewise the same way, purifieth the blood, and recovereth the corruption occasioned by the peccant humour; or other-whiles gathering it together, it thrusteth and carrieth out that evil guest, by the passages contrived by nature to disburden the body of unprofitable or hurtfull superfluities.

CHAP. XXVII.

Of the motions of sense; and of the sensible qualities in general; and in particular, of those which belong to Touch, Taste, and Smelling.

1. The connexion of the subsequent chapters with the precedent.

HAving thus brought on the course of nature as high as living creatures (whose chief species or division is those that have sense) and having declared the operations which are common to the whole tribe of them which includeth both plants and animals; it is now time we take a particular view of those, whose action and passion is the reason why that chief portion of life is tearmed sensitive; I mean the senses, and the qualities, by which the outward world cometh into the living creature through his senses. Which when we shall have gone through, we

we shall scarcely have left any qualities among bodies, to plead for a spiritual manner of being or working; that is, for a self-encity, and instantaneous operation: which kind of things and properties, vulgar Philosophy is very earnest to attribute unto our senses: with what reason, and upon what ground, let us now consider.

2. Of the senses & sensible qualities in general; And of the end for which they serve,

These qualities are reduced to five several heads, answerable to so many different waies, whereby we receive notice of the bodies that are without us. And accordingly, they constitute a like number of different senses: of every one of which, we will discourse particularly, when we have examined the natures of the qualities that affect them. But now, all the consideration we shall need to have of them, is onely this, That it is manifest the organs in us, by which sensible qualities do work upon us, are corporeal, and are made of the like ingredients as the rest of our body is: and therefore must of necessity be liable to suffer evil, and to receive good (in such sort as all other bodies do) from those active qualities which make and mar all things within the limits of nature. By which terms of Evil and Good, I mean those effects that are averse or conformable to the particular nature of any thing; and thereby do tend to the preservation or destruction of that individual.

Now we receiving from our senses the knowledge that we have of things without us, do give names unto them according to the passions and affections which those things cause in our senses: which being the same in all mankind (as long as they are considered in common, and that their effects are looked upon in gross) all the world agreeth in one notion, and in one name of the same thing; for every man living is affected by it, just as his neighbour is, and as all men else in the world are. As for example, heat or cold worketh the same feeling in every man composed of flesh and blood; and therefore whosoever should be asked of them would return the same answer, that they cause such and such effects in his sense, pleasing or displeasing to him, according to their degrees, and as they tend to the good or evil of his whole body.

But if we descend to particulars, we shall finde that several men of differing constitutions, do frame different notions of the same

ſame things, according as they are conformable or diſagreeing to their natures: and accordingly they give them different names. As when the ſame liquor is ſweet to ſome mens taſte, which to anothers appeareth bitter: one man taketh that for a perfume, which to another is an offenſive ſmell: in the Turkiſh baths; (where there are many degrees of heat in divers rooms, through all which the ſame perſon uſeth to paſs, and to ſtay a while in every one of them, both at his entrance and going out, to ſeaſon his body by degrees, for the contrary exceſs he is going unto) that ſeemeth chilly cold at his return; which appeared melting hot at his going in; as I my ſelf have often made experience in thoſe countreys. Beauty and lovelineſs will ſhine to one man in the ſame face, that will give averſion to another. All which proclameth, that the ſenſible qualities of bodies are not any poſitive real thing, conſiſting in an indiviſible, and diſtinct from the body it ſelf; but are meerly the very body, as it affecteth our ſenſes: which to diſcover how they do it, muſt be our labour here.

Let us therefore begin with conſidering the difference that is between ſenſible and inſenſible creatures. Theſe later do lie expoſed to the mercy of all outward agents that from time to time (by the continual motion which all things are in) do come within diſtance of working upon them: and they have no power to remove themſelves from what is averſe to their nature; nor to approach neerer unto what comforteth it. But the other having within themſelves a principle of motion (as we have already declared) whenſoever ſuch effects are wrought upon them, as upon the others; they are able upon their own account and by their own action, to remove themſelves from what beginneth to annoy them, and to come neerer unto what they find a beginning of good by.

Theſe impreſſions are made upon thoſe parts of us, which we call the organes of our ſenſes; and by them do give us ſeaſonable advertiſements and knowledges whereby we may govern and order to the beſt advantage, our little charge of a body, according to the tune or warnings of change in the great circumſtant body of the world, as far as it may concern ours. Which how it is done, and by what ſteps it proceedeth, ſhal be in the following diſcourſe laid open.

Of this great machine that environeth us, we who are but a small parcel, are not immediately concerned in every part of it. It importeth not us for the conservation of our body, to have knowledge of other parts than such as are within the distance of working upon us: those onely within whose sphere of activity we are placed, can offend or advantage us: and of them some are neer us, others farther from us. Those that are next unto us, we discern (according as they are qualified) either by our touch, or by our taste, or by our smelling; which three senses do manifestly appear to consist in a meer gradation of more or less gross; and their operations are levelled to the three elements that press upon us, earth, water, and air. By our other two senses (our hearing and our seeing) we have notice of things farther off: and the agents which work upon them, are of a more refined nature.

3. Of the sense of touching: and that both it and its qualities are bodies

But we must treat of them all in particular: and that which we will begin with shall be the touch, as being the grossest of them, and that which converseth with none but the most material and massie objects. We see it dealeth with heavy consistent bodies, and judgeth of them by conjunction unto them, and by immediate reception of something from them. And according to the divers impressions they make in it, it distinguisheth them by divers names; which (as we said of the qualities of mixed bodies) are generally reduced to certain pairs, as hot and cold, wet and dry, soft and hard, smooth and rough, thick and thin, and some others of the like nature; which were needless to enumerate, since we pretend not to deliver the science of them, but onely to shew that they and their actions are all corporeal.

And this is sufficiently evident, by meer repeating but their very names: for it is plain by what we have already said, that they are nothing else but certain affections of quantity, arising out of different degrees of rarity and density compounded together. And it is manifest by experience, that our sense receiveth the very same impressions from them which another body doth: for our body or our sense will be heated by fire; and will also be burned by it, if the heat be too great, as well as wood: it will be constipated by cold water, moistened by humid things, and dryed by dry bodies, in the same manner as any other body what-

whatsoever; likewise, it may in such sort as they, be wounded and have its continuity broken by hard things; be pleased and polished by those that are soft and smooth; be pressed by those that are thick and heavy; and be rubbed by those that are rugged, &c.

So that those masters who will teach us that the impressions upon sense are made by spiritual or spirit-like things or qualities, which they call intentional species, must labour at two works: the one to make it appear that there are in nature such things as they would perswade us; the other, to prove that these material actions we speak of are not able to perform those effects, for which the senses are given unto living creatures. And until they have done that, I conceive we should be much too blame to admit such things, as we neither have ground for in reason, nor can understand what they are. And therefore we must resolve to rest in this belief, which experience breedeth in us; that these bodies work upon our senses no other waies than by a corporeal operation; and that such a one is sufficient for all the effects we see proceed from them: as in the process of this discourse we shall more amply declare.

4. Of the taste and its qualities: that they are bodies.

The Element immediately next to earth in grossenes, is water. And in it is the exercise of our taste, our mouth being perpetually wet within; by means of which moisture, our tongue receiveth into it some little parts of the substance which we chew in our teeth, and which passeth over it. You may observe how, if we take any herb or fruit, and having chopped or beaten it small, we then put it into a wooden dish of water and do squeeze it a little; the juice communicating and mingling it self with the water, infecteth it with the taste of it self, and remaining a while in the bowl, sinketh by little and little into the very pores of the wood: as is manifest by its retaining a long time after the taste and smell of that herb. In like manner, nature hath taught us by chewing our meat, and by turning it into our mouthes and pressing it a little (that we may the more easily swallow it) to imbue our spittle with such little parts as easily diffuse themselves in water. And than our spittle being continuate to the moisture which is within our tongue, (in such sort as we declared of the moisture of the earth that soaketh into the

root of a plant) and particularly in the sinews of it; must of necessity affect those little sensible strings with the qualities which these petty bodies, mixed every where with the moisture, are themselves imbued withall.

And if you ask what motions or qualities these be: Physicians (unto whom it belongeth most particularly to look into them) will tell you, that some dilate the tongue more, and some less; as if some of these little bodies had an aerial, and others a watry disposition: and these two they express by the names of sweet and fatty. That some do contract and draw the tongue together, as choaky and rough things do most; and next to them crabby and immature sharpness. That some do corrode and pierce the tongue, as salt and sowre things. That bitter things do search the outside of it, as if they swept it: and that other things do as it were prick it, as spices and hot drinks. Now all these are sensible material things, which admit to be explicated clearly, by the varieties of rarity and density concurring to their compositions; and are so proportionable to such material instruments as we cannot doubt but that they may be throughly declared by our former principles.

5. That the smell and its qualities are real bodies.

The next element above water is air, which our nostrils, being our instrument to suck in, we cannot doubt but what affecteth a man by his nose, must come unto him in breath or air. And as humidity receiveth grosser and weightier parts, so those which are more subtile and light, do rise up into the air: and these we know attain unto this lightness by the commixtion of fire, which is hot and dry. And therefore we cannot doubt, but that the nature of smell is more or less tending to heat and drought: which is the cause that their commixtion with the brain, proveth comfortable unto it; because of its own disposition it is usually subject to be too moist and too cold.

Whether there be any immediate instrument of this sense, to receive the passion or effect, which by it other bodies make upon us; or whether the sense it self be nothing but a passage of these exhalations and little bodies unto the brain, fitly accommodated to discern what is good or hurtfull for it, and accordingly to move the body to admit or reject them, importeth

not

not us at present to determine: let Physicians and Anatomists resolve that question, whiles it sufficeth us to understand that the operations of bodies by odours upon our sense, are performed by real and solid parts of the whole substance; which are truly material, though very little bodies; and not by imaginary qualities.

6. Of the conformity betwixt the two senses of smelling and tasting.

And those bodies, when they proceed out of the same things that yield also tastive particles, (although without such material violence, and in a more subtile manner) must of necessity have in them the same nature, which those have that affect the taste; and they must both of them affect a man much alike, by his taste and by his smell: and so are very proportionate to one another; excepting in those properties which require more cold or liquidity than can well stand with the nature of a smell. And accordingly, the very names which men have imposed to express the affections of both, do many times agree: as savour, which is common both to the smell and to the taste; and sweet likewise: the strongest of which we see oftentimes do make themselves known as well by the one as by the other sense; and either of them in excess will turn a mans stomack. And the Physicians that write of the senses finde them very conformable: and therfore it happeneth that the losing of one of them, is the lost also of the other.

And experience teacheth us in all beasts, that the smell is given unto living creatures, to know what meats are good for them, and what are not. And accordingly we see them still smell for the most part at any unknown meat before they touch it; which seldom faileth of informing them rightly: nature having provided this remedy against the gluttony, which could not choose but follow the convenient disposition and temper of their parts and humours; through which they often swallow their meat greedily and suddenly, without expecting to try it first by their taste. Besides that, many meats are so strong, that their very tasting them after their usual manner, would poyson, or at the least greatly annoy them: and therefore nature hath provided this sense to prevent their taste; which being far more subtile than their taste; the small atoms by which it is performed are not so very noxious to the health of the animal, as the other grosser atoms are.

7. The reason why the sense of smelling is not so perfect in man as in beasts: with a wonderfull history of a man who could wind a sent as well as any beast.

And doubtlessely, the like use men would make of this sense, had they not on the one side better means than it to know the qualities of meats: and therefore, this is not much reflected upon. And on the other side, were they not continually stuffed and clogged with gross vapours of steamy meat, which are daily reeking from the table and their stomacks; and permit not purer atoms of bodies, to be discerned; which require clear and uninfected organes to take notice of them. As we see it fare with dogs; who have not so true and sensible noses, when they are high fed, and lie in the kitchin amidst the steams of meat; as when they are kept in their kenel, with a more spare diet, fit for hunting.

One full example, this age affordeth us in this kind, of a man, whose extremity of fear wrought upon him to give us this experiment. He was born in some village of the countrey of *Liege:* and therefore among strangers, he is known by the name of *John* of *Liege.* I have been informed of this story by several (whom I dare confidently believe) that have had it from his own mouth, and have questioned him with great curiosity, particularly about it.

When he was a little boy, there being wars in the countrey (as that State is seldome without molestations from abroad, when they have no distempers at home, which is an unseparable effect of a countries situation upon the frontiers of powerfull neighbouring Princes that are at variance) the village of whence he was, had notice of some unruly scattered troops that were coming to pillage them: which made all the people of the village flie hastily with what they could carry with them, to hide themselves in the woods: which were spacious enough to afford them shelter, for they joyned upon the forrest of *Ardenne.* There they lay, till some of their scouts brought them word, that the souldiers of whom they were in such apprehension, had fired their town and quitted it. Then all of them returned home, excepting this boy; who it seemeth, being of a very timorous nature, had images of fear so strong in his fantasie, that first, he ran farther into the wood than any of the rest; and afterwards apprehended that every body he saw through the thickets, and every voice he heard was the souldiers: and so hid himself from his

his parents that were in much distress seeking him all about, and calling his name as loud as they could. When they had spent a day or two in vain, they returned home without him, and he lived many years in the woods, feeding upon roots, and wild fruits, and mast.

He said that after he had been some time in this wild habitation, he could by the smell judge of the taste of any thing that was to be eaten: and that he could at a great distance wind by his nose, where wholesome fruits or roots did grow. In this state he continued (still shunning men with as great fear as when he first ran away; so strong the impression was, and so little could his little reason master it) until in a very sharp winter, that many beasts of the forrest perished for want of food, necessity brought him to so much confidence, that leaving the wild places of the forest, remote from all peoples dwellings, he would in the evenings steal among cattel that were fothered; especially the swine, and among them, glean that which served to sustain wretchedly his miserable life. He could not do this so cunningly, but that returning often to it, he was upon a time espied: and they who saw a beast of so strange a shape (for such they took him to be, he being naked and all overgrown with hair) believing him to be a satyre, or some such prodigious creature as the recounters of rare accidents tell us of, laid wait to apprehend him. But he that winded them as far off, as any beast could do, still avoided them, till at length, they laid snares for him, and took the wind so advantagiously of him, that they caught him: and then, soon perceived he was a man; though he had quite forgotten the use of all language: but by his gestures and cries, he expressed the greatest affrightedness that might be. Which afterwards he said (when he had learned anew to speak) was because he thought, those were the souldiers he had hidden himself to avoid, when he first betook himself to the wood; and were alwaies lively in his fantasie, through his fears continually reducing them thither.

This man within a little while after he came to good keeping and full feeding, quite lost that acutenss of smelling which formerly governed him in his taste; and grew to be in that particular as other ordinary men were. But at his first living with other

7. The reason why the sense of smelling is not so perfect in man as in beasts: with a wonderfull history of a man who could wind a sent as well as any beast.

And doubtlessely, the like use men would make of this sense, had they not on the one side better means than it to know the qualities of meats: and therefore, this is not much reflected upon. And on the other side, were they not continually stuffed and clogged with grosse vapours of steamy meat, which are daily reeking from the table and their stomacks; and permit not purer atoms of bodies, to be discerned; which require clear and uninfected organes to take notice of them. As we see it fare with dogs; who have not so true and sensible noses, when they are high fed, and lie in the kitchin amidst the steams of meat; as when they are kept in their kenel, with a more spare diet, fit for hunting.

One full example, this age affordeth us in this kind, of a man, whose extremity of fear wrought upon him to give us this experiment. He was born in some village of the countrey of *Liege*: and therefore among strangers, he is known by the name of *John* of *Liege*. I have been informed of this story by several (whom I dare confidently believe) that have had it from his own mouth, and have questioned him with great curiosity, particularly about it.

When he was a little boy, there being wars in the countrey (as that State is seldome without molestations from abroad, when they have no distempers at home, which is an unseparable effect of a countries situation upon the frontiers of powerfull neighbouring Princes that are at variance) the village of whence he was, had notice of some unruly scattered troops that were coming to pillage them: which made all the people of the village flie hastily with what they could carry with them, to hide themselves in the woods: which were spacious enough to afford them shelter, for they joyned upon the forrest of *Ardenne*. There they lay, till some of their scouts brought them word, that the souldiers of whom they were in such apprehension, had fired their town and quitted it. Then all of them returned home, excepting this boy; who it seemeth, being of a very timorous nature, had images of fear so strong in his fantasie, that first, he ran farther into the wood than any of the rest; and afterwards apprehended that every body he saw through the thickets, and every voice he heard was the souldiers: and so hid himself from his

his parents that were in much distress seeking him all about, and calling his name as loud as they could. When they had spent a day or two in vain, they returned home without him, and he lived many years in the woods, feeding upon roots, and wild fruits, and mast.

He said that after he had been some time in this wild habitation, he could by the smell judge of the taste of any thing that was to be eaten: and that he could at a great distance wind by his nose, where wholesome fruits or roots did grow. In this state he continued (still shunning men with as great fear as when he first ran away; so strong the impression was, and so little could his little reason master it) until in a very sharp winter, that many beasts of the forrest perished for want of food, necessity brought him to so much confidence, that leaving the wild places of the forest, remote from all peoples dwellings, he would in the evenings steal among cattel that were fothered; especially the swine, and among them, glean that which served to sustain wretchedly his miserable life. He could not do this so cunningly, but that returning often to it, he was upon a time espied: and they who saw a beast of so strange a shape (for such they took him to be, he being naked and all overgrown with hair) believing him to be a satyre, or some such prodigious creature as the recounters of rare accidents tell us of, laid wait to apprehend him. But he that winded them as far off, as any beast could do, still avoided them, till at length, they laid snares for him, and took the wind so advantagiously of him, that they caught him: and then, soon perceived he was a man; though he had quite forgotten the use of all language: but by his gestures and cries, he expressed the greatest affrightedness that might be. Which afterwards he said (when he had learned anew to speak) was because he thought, those were the souldiers he had hidden himself to avoid, when he first betook himself to the wood; and were alwaies lively in his fantasie, through his fears continually reducing them thither.

This man within a little while after he came to good keeping and full feeding, quite lost that acutenss of smelling which formerly governed him in his taste; and grew to be in that particular as other ordinary men were. But at his first living with other

other people, a woman that had compassion of him to see a man so neer like a beast; and that had no language to call for what he wished or needed to have; took particular care of him; and was alwaies very solicitous to see him furnished with what he wanted: which made him so apply himself unto her in all his occurrents, that whensoever he stood in need of ought, if she were out of the way, and were gone abroad into the fields, or to any other village neer by, he would hunt her out presently by his sent, in such sort as with us those dogs use to do which are taught to draw dry foot. I imagine he is yet alive to tell a better story of himself than I have done; and to confirm what I have here said of him: for I have from them who saw him but few years agone, that he was an able strong man, and likely to last yet a good while longer.

And of another man, I can speak assuredly my self, who being of a very temperate or rather spare diet, could likewise perfectly discern by his smell the qualities of whatsoever was afterwards to pass the examination of his taste, even to his bread and beer. Wherefore to conclude, it is evident both by reason, and by experience, that the objects of our touch, our taste, and our smell, are material and corporeal things, derived from the division of quantity, into more rare and more dense parts; and may with ease be resolved into their heads and springs sufficiently to content any judicious and rational man. Who if he be curious to have farther satisfaction in this particular (as far as concerneth odours and savours) may look over what *Joannes Bravus* (that judicious, though unpolished Physician of *Salamanca*) hath written thereof.

THE

THE EIGHT AND TWENTIETH CHAPTER.

Of the ſenſe of hearing, and of the ſenſible quality ſound.

BUt to proceed with the reſt of the ſenſes: becauſe nature ſaw that ſome things came ſuddenly upon a living creature, which might do it hurt, if they were not perceived afar off: and that other things were placed at diſtance from it, which would greatly help it, if it could come neer unto them; ſhe found a means to give us two ſenſes more, for the diſcovery of remote things. The one principally & particularly to diſcry their motion. The other to mark their bulk and ſituation. 1 Of the ſenſe of hearing: and that ſound is purely motion.

And ſo to begin with the former of theſe; we muſt needs acknowledge (after due examination of the matter) that the thing which we cal ſound is purely motion. And if it be objected that many motions are made without any diſcernable ſound: We ſhall not make difficulty to grant it; conſidering that many motions die, before they come to touch the eare; or elſe are ſo weak, that they are drowned by other ſtronger motions, which round about beſiege our eares in ſuch manner, that notice is not taken of theſe: for ſo it fareth in what dependeth meerely of quantity, eſpecially, concerning our ſenſes, that not everything of the kind, but a terminate quantity or multitude of parts of it maketh an object ſenſible.

But to come cloſe to the point; we ſee that ſound, for the moſt part, is made in the ayre; and that to produce it, there is required a quicke and ſmart motion of that Element, which of all the reſt, is the moſt moveable. and in motion velocity or quickneſs, is proportionate to denſity in magnitude (as we have at large declared.) Which maketh quantity become perceptible in bulk, as this doth in motion. And as the one conſiſteth in a greater proportion of ſubſtance to the ſame quantity; ſo the other doth in the paſſage of more parts of the medium in the ſame time.

And in the moderating of this, ſuch of the liberall Arts are employed, which belong to the cultivating mans voice; as Rhetoricke, meetering, and ſinging. It is admirable how finely Ga-

2 Of divers arts belonging to the ſenſe of hearing: all which confirm that ſound is nothing but motion.

lileo hath delivered us the conſonances of Muſick towards the end of his firſt Dialogue of motion; from the 95 page forward on: and how he hath ſhewed that matter cleerly unto the ſight (ſo making the eye, as well as the eer judge of it) in motions of the water, in pendants hanging looſe in the ayre, and in permanent notes or races made upon letton. To the moderation of the ſame, many other mechanicall arts are applied; as the trade of bel-founders; and of all makers of muſical inſtruments by wind, or by water, or by ſtrings.

Neither can I ſlip over without mentioning the two curious arts of Echoing and of whiſpering. The firſt of which teacheth to iterate voyces ſeveral times; and is frequently put in practice by thoſe that are delighted with rarities in their gardens. And the other ſheweth how to gather into a narrow roome the motions of the ayre, that are diffuſed in a great extent; whereby, one that ſhall put his eare to that place, where all the ſeverall motions do meet, ſhall hear what is ſpoken ſo low, as no body between him, and the ſpeaker, can diſcern any ſound at all. Of which kind, there are very fine curioſities in ſome Churches of England: and my ſelfe have ſeen, in an upper room of a capacious round Tower vauted overhead, the wals ſo contrived (by chance I beleeve) that two men ſtanding at the utmoſt oppoſite points of the Diameter of it, could talke very currently and cleerly with one and other; and yet none that ſtood in the middle could heare a ſyllable. And if he turned his face to the wall and ſpoke againſt that (though never ſo ſoftly) the others eare, at the oppoſite point would diſcerne every word. Which putteth me in mind of a note made by one that was no friend to auricular confeſſion; upon his occaſion of his being with me in a Church that had been of a moneſtary; where, in one corner of it, one might ſit and heare almoſt all that was whiſpered through the whole extent of the Church: who would not be perſwaded but that it was on purpoſe contrived ſo by the ſubtilty of the Friars; to the end that the Prior or ſome one of them might ſit there and hear whatſoever the ſeverall Penitents accuſed themſelves of to their ghoſtly fathers; ſo to make advantage by this artifice, of what the confeſſors durſt not of themſelves immediately reveale.

He allowed better of the uſe in Rome of making voyces rebound

bound from the top of the cupula of St. Peters in the Vatican down to the floore of the Church; when on great daies they make a Quire of Muſike goe up to the very higheſt part of the arch, which is, into the Lanthorn: from whence while they ſing the people below juſt under it are ſurprized with the ſmart ſound of their voices, as though they ſtood cloſe by them, and yet can ſee no body from whom thoſe notes ſhould proceed. And in the ſame cupula, if two men ſtand upon the large corniſh or bord, which circleth the bottom of it, they may obſerve the like effect, as that which I ſpoke of above in the round Tower.

In the like manner, they that are called ventriloqui, do perſwade ignorant people, that the devil ſpeaketh frō within them (deep in their belly) by their ſucking their breath inwards in a certain manner while they ſpeake: whence it followeth, that their voice ſeemeth to come, not from them, but from ſomewhat elſe hidden within them; if (at the leaſt) you perceive it commeth out of them: but if you do not, then it ſeemeth to come from a good way off.

To this art belongeth the making of Sarabatanes, or Trunks, to help the hearing; and of Echo glaſſes, that multiply ſounds, as burning glaſſes do light. All which arts, and the rules of them do follow the laws of motion: and every effect of them is to be demonſtrated by the principles and proportions of motion: and therefore, we cannot with reaſon imagine them to be any thing elſe.

3. The ſame is confirmed by the effects cauſed by great noiſes.

We ſee likwiſe, that great noiſes not only offend the hearing, but even ſhake houſes & Towers. I have been told by inhabitants of Dover, that when the Arch-Duke Albertus made his great battery againſt Calais (wch for the time was a very furious one, for he endeavored al he could to take the town before it could be relieved) the very houſes were ſhaken, & the glaſſe-windows were ſhivered, with the report of his Artillery. And I have been told by one that was in Sevil, when the gunpowder-houſe of that Town (which was ſome two miles diſtant from that place where he lived) was blown up, that it made the wooden ſhutters of the windows in his houſe, beat & clap againſt the walls with great violence, and did ſplit the very wall of a faire Church, that ſtanding next it (though at a good diſtance) had no other building betweene to ſhelter it from the

impetuosity of the ayres ſudden violent motion.

And after a fight I once had with ſome Galleaſſes and Gallions in the rode of Scanderone (which was a very hot one for the time, and a ſcarce credible number of pieces of Ordnance were ſhot from my fleete) the Engliſh Conſul of that place comming afterwards abord my ſhip, told me that the report of our guns had during all the time of the fight ſhaken the drinking-glaſſes that ſtood upon ſhelves in his houſe; and had ſplit the paper-windows all about; and had ſpoiled and cracked all the egges that his Pigeons were then ſitting upon: which loſſe he lamented exceedingly; for they were of that kind, which commonly is called *Carriers*, & ſerve them daily in their commerce between that place and Aleppo.

And I have often obſerved at ſea, in ſmooth water, that the Ordnance ſhot off in a ſhip ſome miles diſtant, would violently ſhake the glaſſe windows in another. And I have perceived this effect in mine owne, more then once, at the report of a ſingle gun from a ſhip ſo far off, that we could not deſcry her. I remember how one time upon ſuch an occaſion, we altered our courſe and ſteared with the ſound, or rather with the motion at the firſt, obſerving upon which point of the Compaſſe the ſhaking appeared (for we heard nothing; though ſoon after with much attention and ſilence we could diſcerne a dull clumſie noiſe: and ſuch a motion groweth at the end of it ſo faint, that if any ſtrong reſiſting body checke it in its courſe, it is preſently deaded, and wil afterwards ſhake nothing beyond that body: and therefore it is perceptible only at the outſide of the ſhip, if ſome light & very moveable body do hang looſely on that ſide it cometh, to receive the impreſſion of it: as this did at the gallery windows of my cabin upon the poop, which were of light Moſcovia glaſs or talk:) and by then we had run ſomewhat more then a watch, wth all the ſails abroad we could make, & in a fair loom gale, we found our ſelves neer enough to part the fray of two ſhips, that in a little while longer fighting would have ſunk one another.

4. That ſolid bodies may convey the motion of the ayre or ſound to the organe of hearing.

But beſides the motions in the ayre (which received them eaſily by reaſon of the fluidity of it) we ſee that even ſolid bodies do participate of it. As if you knock never ſo lightly at one end of the longeſt beam you can find, it will be diſtinctly hard at the other end: the trampling of men and horſes in a quiet night will

turn forward one Leaf. be

be heard ſome miles off, if one lay their eare to the ground; and more ſenſibly if one make a little hole in the earth, and put ones eare into the mouth of it; but moſt of all if one ſet a Drum ſmooth upon the ground, and lay ones eare to the upper end of it; for the lower membrane of the Drum is ſhaked by the motion of the earth, and then multiplyeth that ſound by the hollow figure of the Drum in the conveying it to the upper membrane, upon which your eare leaneth. Not much unlike the tympane or drum of the eare; which being ſhaked by outward motion, cauſeth a ſecond motion on the inſide of it correſpondent to this firſt; and this having a free paſſge to the brain, ſtriketh it immediately, and ſo informeth it how things move without; which is all the myſtery of hearing.

5 Where the motion is interrupted there is no ſound.

It any thing doe break or ſtop this motion, before it ſhake our eare, it is nor heard. And accordingly we ſee that the ſound of bells or artillery is heard much further if it have the conduct of waters, than through the pure ayr: becauſe in ſuch bodies the great continuity of them maketh that one part cannot ſhake alone, and upon their ſuperficies, there is no notable unevenneſſe, nor no denſe thing in the way to check the motion (as in the ayr, hils, buildings, trees, & ſuch like:) ſo that the ſame ſhakeing goeth a great way. And to confirm that this is the true reaſon, I have ſeveral times obſerved, that ſtanding by a river ſide, I have heard the ſound of a ring of bells, much more diſtinctly and lowd, than if I went ſome diſtance from the water, though neerer to the ſteeple from whence the ſound came.

6. That not only the motion of the air, but all other motions comming to our ears make ſounds.

And it is not only the motion of the ayr, that maketh ſound in our eares: but any motion that hath acceſſe to them in ſuch a manner as to ſhake the quivering membranous tympane within them, will repreſent unto us thoſe motions which are without, and ſo make ſuch a ſound there as if it were conveyed onely by the ayr. Which is plainly ſeen, when a man lying a good way under water, ſhall there hear the ſame ſounds, as are made above in the ayr; but in a more clumſie manner; according as the water, by being thicker, and more corpulent, is more unwieldly in its motions. And this I have tried often; ſtaying under water as long as the neceſſity of breathing would permit me. Which ſheweth that the ayr being ſmartly moved, moveth the water alſo, by means of its continuity with it; and that li-

quid element, being fluid and getting into the eare, maketh vibrations upon the drum of it like unto those of ayr.

7. How one sense may supply the want of an other.

But all this is nothing in respect of what I might in some sort say, and yet speak truth. Which is, that I have seen one, who could discern sounds with his eyes. It is admirable, how one sense will oftentimes supply the want of an other: whereof I have seen an other strange example in a different strain from this; of a man that by his grosser senses had his want of sight wonderfully made up. He was so throughly blind, that his eyes could not inform him when the Sun shined; for all the crystalline humour was out in both his eyes: yet his other senses instructed him so efficaciously in what was their office to have done; as what he wanted in them, seemed to be overpayed in other abilities. To say that he would play at cards and tables as well as most men, is rather a commendation of his memory and fansie, than of any of his outward senses. But that he should play well at boules and shovelbord, and other games of aym, which in other men do require clear sight, and an exact levell of the hand according to the qualities of the earth or table, and to the situation and distance of the place he was to throw at, seemeth to exceed possibility: and yet he did all this.

He would walk in a chamber or long alley in a garden (after he had been a while used to them) as straight, and turn as just at the ends, as any seeing man could doe. He would go up and down every where so confidently, and demean himselfe at table so regularly, as strangers have sitten by him severall meals and have seen him walk about the house, without ever observing any want of seeing in him: which he endeavoured what he could to hide, by wearing his hat low upon his browes. He would, at the first abord of a stranger, as soon as he spoke to him, frame a right apprehension of his stature, bulk and manner of making. And which is more, when he taught his scholars to declame (for he was schoolmaster to my sonnes and lived in my house) or to represent some of Seneca's Tragedies, or the like, he wou'd by their voice know their gesture, and the situation they put their bodies in: so that he would be able, as soon as they spoke, to judge whether they stood or sate, or in what posture they were; which made them demean themselves as decently before him whiles they spoke, as if he had seen them perfectly.

Though

Though all this be very ſtrange, yet me thinks his diſcerning of light is beyond it all. He would feel in his body, and chiefly in his brain (as he hath often told me) a certain effect by which he did know when the Sun was up; and would diſcern exactly a clear from a cloudy day. This I have known him frequently do without miſſing, when for triall ſake he hath been lodged in a cloſe chamber, whereunto the clear light or Sun could not arrive to give him any notice by its actuall warmth; nor any body could come to him, to give him private warnings of the changes of the weather.

8 Of one who could diſcern ſounds of words with his eyes.

But this is not the relation I intended, when I mentioned one that could hear by his eyes; (if that expreſſion may be permitted me) I then reflected upon a Noble man of great quality that I knew in Spain, the younger brother of the Conſtable of Caſtile. But the reflection of his ſeeing of words, called into my remembrance the other that felt light: in whom I have often remarked ſo many ſtrange paſſages, with amazement and delight; that I have adventured upon the Readers patience to record ſome of them, conceiving they may be of ſome uſe in our courſe of doctrine. But the Spaniſh Lord was born deaf; ſo deaf, that if a Gun were ſhot off cloſe by his ear, he could not hear it; and conſequently, he was dumb, for not being able to hear the ſound of words, he could never imitate nor underſtand them. The lovelineſſe of his face, and eſpecially the exceeding life and ſpiritfulneſs of his eyes, and the comelineſſe of his perſon, and whole compoſure of his body throughout, were pregnant ſignes of a well tempered mind within. And therefore all that knew him lamented much the want of meanes to cultivate it, and to imbrue it with the notions which it ſeemed to be capable of in regard of its ſelf, had it not been ſo croſſed by this unhappy accident. Which to remedy Phyſicians and Chirurgians had long imployed their skill; but all in vain. At the laſt, there was a Prieſt who undertook the teaching him to underſtand others when they ſpoke, and to ſpeak himſelf that others might underſtand him. What at the firſt he was laught at for, made him after ſome yeers be looked upon as if he had wrought a miracle. In a word; after ſtrange patience, conſtancy and paines, he brought the young Lord to ſpeak as diſtinctly as any man whoſoever; and to underſtand ſo perfectly what

others ſaid that he would not loſe a word in a whole daies converſation.

They who have a curioſity to ſee by what ſteps the maſter proceeded in teaching him, may ſatisfie it by a book which he himſelf hath writ in Spaniſh upon that ſubject, to inſtruct others how to teach deaf and dumb perſons to ſpeak. Which when he ſhall have looked heedfully over, and ſhall have conſidered what a great diſtance there is between the ſimplicity and nakedneſſe of his firſt principles, and the ſtrange readineſſe and vaſt extent of ſpeech reſulting in proceſſe of time out of them; he will forbear pronouncing an impoſſibility in their pedegree, whiles he wondereth at the numerous effects reſulting in bodies out of rarity and denſity, ingeniouſly mingled together by an all-knowing Architect, for the production of various qualities among mixts, of ſtrange motions in particular bodies, and of admirable operations of life and ſenſe among vegetables and animals. All which are ſo many ſeveral words of the myſtical language, which the great maſter hath taught his otherwiſe dumb ſcholars (the creatures) to proclame his infinite art, wiſdome, perfections, and excellency in.

The Prieſt who by his book and art occaſioned this diſcourſe, I am told is ſtill alive, and in the ſervice of the Prince of Carignan, where he continueth (with ſome that have need of his pains) the ſame imployment as he did with the Conſtables brother: with whom I have often diſcourſed, whiles I waited upon the Prince of Wales (now our gracious Soveraign) in Spain. And I doubt not but His Majeſty remembreth all I have ſaid of him, and much more: for His Majeſty was very curious to obſerve and enquire into the utmoſt of it. It is true, one great misbecomingneſs he was apt to fall into whiles he ſpoke, which was an uncertainty in the tone of his voyce; for not hearing the ſound he made when he ſpoke, he could not ſteadily govern the pitch of his voyce; but it would be ſometimes higher, ſometimes lower; though, for the moſt part, what he delivered together, he ended in the ſame key as he begun it. But when he had once ſuffered the paſſage of his voice to cloſe, at the opening them again, chance, or the meaſure of his earneſtneſſe to ſpeak or to reply, gave him his tone: which he was not capable of moderating by ſuch an artifice, as is recorded Caius Gracchus uſed,

when

when passion, in his orations to the people, drove out his voyce with too great a vehemence or shrilnesse.

He could discern in another whether he spoke shrill or low: and he would repeat after any body, any hard word whatsoever. Which the Prince tryed often; not to mock him in English, but by making some Welchmen that served his Highnesse, speak words of their language. Which he so perfectly ecchoed, that I confesse I wondered more at that than at all the rest. And his Master himself would acknowledge, that the rules of his art reached not to produce that effect with any certainty. And therefore concluded, this in him must spring from other rules he had framed unto himself, out of his own attentive observation: which, the advantage that nature had justly given him in the sharpenesse of his other senses, to supply the want of this, endowed him with an ability and sagacity to do beyond any other man that had his hearing. He expressed it (surely) in a high measure, by his so exact imitation of the Welch pronunciation: for that tongue (like the Hebrew) employeth much the gutturall Letters: and the motions of that part which frameth them cannot be seen nor judged by the eye, otherwise than by the effect they may happily make by consent in the other parts of the mouth, exposed to view: for the knowledge he had of what they said, sprung from his observing the motions they made; so that he could converse currently in the light, though they he talk'd with whispered never so sofily. And I have seen him at the distance of a large chamber's breadth, say words after one, that I standing close by the speaker could not hear a syllable of. But if he were in the dark, or if one turned his face out of his sight, he was capable of nothing one said.

But it is time that we return to our theam, from whence my blind schoo'master, and this deaf Prince (whose defects were overpayed an other way) have carried us with so long a digression. Which yet will not be altogether useless (no more than the former, of the wild man of Liege) if we make due reflections upon them: for when we shall consider, that odors may be tasted; that the relish of meats may be smelled; that magnitude and figure may be heard; that light may be felt; and that sounds may be seen; (all which is true in some sense) we may by this changing the offices of the senses, and by looking into

9 Diverse reasons to prove sound to be nothing else but a motion of some reall body.

into the cauſes thereof; come to diſcern that theſe effects are not wrought by the intervention of aery qualities; but by reall and materiall applications of bodies to bodies; which in different manners do make the ſame reſults within us.

But when I ſuffered my pen to be ſteered by my fanſie, that pleaſed it ſelf, and rioted in the remembrance of theſe two notable perſons: I was ſpeaking, how the ſtrong continuity of the parts of a thing that is moved, draweth on the motion, and conſequently the ſound, much further than where that which is moved ſuffereth breaches, or the rarity of it occaſioneth that one part may be moved without an other; for to the proportion of the ſhaking, the noiſe continueth. As we ſee in trembling bells, that hum a great while longer than others, after the Clapper hath ſtrucken them: and the very ſound ſeemeth to quiver and ſhake in our eares, proportionable to the ſhaking of the bell. And in a Lute as long as a ſtring that hath been ſtrucken, ſhaketh ſenſibly to our eye; ſo long and to the ſame meaſure, the ſound ſhaketh in our eare. Which is nothing elſe but an undulation of the Ayr, cauſed by the ſmart and thick vibrations of the cord, and multiplyed in the belly of the inſtrument (which is the reaſon that the concave figure is affected in moſt) and ſo when it breaketh out of the inſtrument in greater quantity, than the ſtring immediately did ſhake; it cauſeth the ſame undulations in the whole body of Ayre round about. And that, ſtriking the Drum of the eare, giveth notice therein what tenour the ſtring moveth: whoſe vibrations if one ſtop by laying his finger upon it, the ſound is inſtantly at an end, for then there is no cauſe on foot, that continueth the motion of the Ayre; which, without a continuation of the impulſe, returneth ſpeedily to quiet; through the reſiſtance made unto it, by other parts of it that are further off.

Out of all which it is plain, that motion alone is able to effect and to give account of all things whatſoever that are attributed to ſound; and that ſound and motion, do go hand in hand together; and that whatſoever is ſaid of the one is likewiſe true of the other. Wherefore it cannot be denyed, but that *hearing* is no thing elſe but the due perception of *motion:* and that *motion* and *ſound* are in themſelves one and the ſame thing, though expreſſed by different names, and compriſed in our underſtanding

derſtanding under different notions. Which propoſition ſeemeth to be yet further convinced, by the ordinary experience of perceiving muſick by mediation of a ſtick; for how ſhould a deaf man be capable of muſick by holding a ſtick in his teeth, whoſe other end lyeth upon the Viall or Virginalls, were it not that the proportionall ſhaking of the ſtick (working a like dauncing in the mans head) did make a like motion in his brain, without paſſing through his eare? and conſequently, without being otherwiſe *ſound*, than as bare motion is *ſound*.

Or if any man will ſtill perſiſt in having ſound be ſome other thing than as wee ſay; and that it affecteth the ſenſe otherwiſe than purely by motion: hee muſt nevertheleſſe acknowledge, that whatſoever it be, it hath neither cauſe nor effect, nor breeding, nor dying, that we either know or can imagine: and then, if he will let reaſon ſway, hee will conclude it unreaſonable to ſay or ſuſpect ſo ill-grounded a ſurmiſe, againſt ſo clear and ſolid proofs, which our eares themſelves do not a little confirm; their whole figure and nature tending to the perfect receiving, conſerving, and multiplying the motions of ayre which happen without a man: as who is curious, may plainly ſee in the Anatomiſts books and diſcourſes.

THE NINE AND TWENTIETH CHAPTER.

Of Sight, and Colours.

THERE is yet left, the object of our ſight, *which we call colours*, to take a ſurvey of; for as for *light*, wee have at large diſplayed the nature and properties of it: from which whether colour be different or no, will be the queſtion we ſhall next diſcuſſe: for thoſe who are cunning in Opticks, will by refractions and by reflexions make all ſorts of colours out of pure light: as we ſee in Rainbows, in thoſe triangular glaſſes, or priſmes which ſome do call *fooles Paradiſes*, and in other inventions for this purpoſe. Wherefore in brief, to ſhew what colour is, let us lay for a ground, that light is of all other things in the world, the greateſt and the moſt powerfull agent upon our eye, either by it ſelf, or by what commeth in with it: and that,

1. That colours are no thing but light mingled with darkneſſe; or the diſpoſition of a bodies ſuperficies apt to reflect light ſo mingled.

that, where light is not, darkneſſe is; then conſider, that light being diverſly to be caſt, but eſpecially, through or from a tranſparent body, into which it ſinketh in part, and in part it doth not; and you will conclude, that it cannot chooſe but come out from ſuch a body in divers ſorts mingled with darkneſſe: which if it be in a ſenſible quantity, doth accordingly make divers appearances: and thoſe appearances muſt of neceſſity have divers hues, repreſenting the colours which are middle colours between white and black; ſince white is the colour of light, and darkneſſe ſeemeth black. Thus, thoſe colours are ingendred, which are called apparent ones. And they appear ſometimes but in ſome one poſition; as the Rainbow; which changeth place as the looker on doth: but at other times, they may be ſeen from any part; as thoſe which light maketh by a double refraction through a triangular glaſſe.

And that this is rightly delivered, may be gathered out of the conditions requiſite to their production: for that cryſtall, or water, or any refracting body, doth not admit light in all its parts, is evident, by reaſon of the reflection that it maketh, which is exceeding great: and not onely from the ſuperficies, but even from the middle of the body within: as you may ſee plainly, if you put it in a dark place, and enlighten but one part of it: for then, you may perceive, as it were, a current of light paſſe quite through the body, although your eye be not oppoſite to the paſſage: ſo that, manifeſtly it reflects to your eye, from all the inward parts which it lighteth upon.

Now a more oblique reflection or refraction doth more diſperſe the light, and admitteth more privations of light in its parts, than a leſſe oblique one: as Galileo hath demonſtrated in the firſt Dialogue of his ſyſteme. Wherefore, a leſſe oblique reflection or refraction, may receive that in quality of light, which a more oblique one maketh appear mingled with darkneſſe; and conſequently, the ſame thing will appear colour in one, which ſheweth it ſelf plain light in the other; for the greater the inclination of an angle is, the greater alſo is the diſperſion of the light.

And as colours are made in this ſort, by the medium through which light paſſeth, ſo if we conceive the ſuperficies from which the light reflecteth, to be diverſly ordered in reſpect of reflexi-

on;

on; it must of necessity follow that it will have a divers lustre and sight, as we see by experience in the necks of Pigeons, and in certain positions of our eye, in which the sight passing through our eye brows, maketh an appearance as though we saw divers colours streaming from a candle we look upon. And accordingly we may observe how some things, or rather most, do appear of a colour more inclining to white, when they are irradiated with a great light, then when they stand in a lesser. And we see Painters heighten their colours, and make them appeare lighter by placing deep shadows by them: even so much, that they will make objects appeare neerer and further off, meerly by the mixtion of their colours. Because objects, the neerer they are, the more strongly and lively they reflect light, and therefore appeare the clearer, as the others do more dusky.

2. Concerning the disposition of these bodies which produce white or black colours.

Therefore, if we put the superficies of one body to have a better disposition for the reflection of light, then another hath; we cannot but conceive, that such difference in the superficies, must needs beget variety of permanent colours in the bodies. And according as the superficies of the same body, is better, or worse disposed to reflection of light, by polishing or by compressure together, or the like: so, the same body, remaining the same in substance, will shew it selfe of a different colour. And it being evident that white (which is the chiefest colour) doth reflect most light: and as evident, that black reflecteth least light; so that it reflecteth shadowes in lieu of colours (as the Obsidian stone among the Romans doth witnesse.) And it being likewise evident, that to be dense and hard, and of small parts, is the disposition of the object which is most apt to reflect light: we cannot doubt, but that *white* is that disposition of the superficies. That is to say, it is the superficies, of a body consisting of dense, of hard and of small parts; and on the contrary side, that black is the disposition of the superfices, which is most soft and full of greatest pores; for when light meeteth with such a superfices, it getteth easily into it; and is there, as it were absorpt and hidden in caves, and commeth not out againe to reflect towards our eye.

This doctrine of ours of the generation of colours, agreeth exactly

3 The former doctrine confirmed by Aristotles authority, reason, & experience.

exactly with *Aristotles* principles, and followeth evidently out of his definitions of *light*, and of colours. And for summing up the general sentiments of mankind in making his Logicall definitions, I think no body will deny his being the greatest Master that ever was. He defineth light to be *actus Diaphani*: which we may thus explicate. It is that thing, which maketh a body that hath an aptitude or capacity of being seene quite through it in every interior part of it, to be actually seen quite through, according to that capacity of it. And he defineth colour to be, *The terme or ending of a diaphanous body*: the meaning whereof is: that colour is a thing which maketh a diaphanous body to reach no further; or that colour is the cause why a body is no further diaphanous, then untill where it beginneth; or that colour is the reason, why we can see no further then to such a degree, through or into such a body,

Which definition fitteth most exactly with the thing it giveth us the nature of. For it is evident, that when we see a body, the body we see hindereth us from seeing any other, that is in a straight line beyond it. And therefore it cannot be denyed, but that colour terminateth, and endeth the diaphaneity of a body, by making it selfe be seen. And all men do agree in conceiving this to be the nature of colour; and that it is a certaine disposition of a body, whereby that body commeth to be seene. On the other side, nothing is more evident, then that to have us see a body, light must reach from that body to our eye. Then adding unto this what Aristotle teacheth concerning the production of seeing: which he saith is made by the action of the seene body upon our sense: it followeth, that the object must work upon our sense, either by light, or at the least with light: for light rebounding from the object round about by straight lines, some part of it must needs come from the object to our eye. Therefore, by how much an object sendeth more light unto our eye, by so much, that object worketh more upon it.

Now seeing that divers objects do send light in divers manners to our eye, according to the divers natures of those objects in regard of hardnesse, density, and littlenesse of parts: we must agree that such bodies do work diversly, and do make different motions or impressions upon our eye: & consequently

ly, the paſſion of our eye from ſuch objects muſt be divers. But there is no other diverſity of paſſion in the eye from the object in regard of ſeeing, but that the object appear divers to us in point of colour. Therefore we muſt conclude, that divers bodies (I meane divers or different, in that kind we here talke of) muſt neceſſarily ſeem to be of divers colours, meerly by the ſending of light unto our eye in divers fashions. Nay, the very ſame object may appear of different colours, whenſoever it happeneth that it reflecteth light differently to us. As we ſee in cloth, if it be gathered together in fouldes, the bottomes of thoſe fouldes ſhew to be of one kind of colour, and the tops of them, or where the cloth is ſtretched out to the full percuſſion of light, it appeareth to be of an other much brighter colour. And accordingly painters are faine to uſe almoſt oppoſite colours to expreſſe them. In like manner, if you look upon two pieces of the ſame cloth, or pluſh, whoſe graines lye contrawiſe to one an other, they will likewiſe appeare to be of different colours. Both which accidents, and many others like unto them in begetting various repreſentations of colours, do all of them ariſe out of lights being more or leſſe reflected from one part then from an other.

4 How the diverſity of colours do follow our various degrees of rarity and denſity.

Thus then you ſee, how colour is nothing elſe, but the diſpoſition of a bodies ſupperficies, as it is more or leſs apt to reflect light; ſithence the reflection of light is made from the ſuperficies of the ſeen body, & the variety of its reflexion begetteth variety of colours. But a ſuperficies is more or leſſe apt to reflect light, according to the degrees of its being more or leſſe penetrable by the force of light ſtriking upon it; for thoſe rayes of light that gaine no entrance into a body they are darted upon, muſt of neceſſity fly back againe from it. But if light doth get enterance and penetrate into the body, it either paſſeth quite through it; or elſe it is ſwallowed up & loſt in that body. The former conſtituteth a diaphanous body; as we have already determined. And the ſemblance which the latter wil have in regard of colour, we have alſo ſhewed muſt be black.

But let us proceede a little further. We know that two things render a body penetrable, or eaſie to admit an other body into it. Holes, (ſuch as we cal pores) & ſoftneſs or humidity; ſo that dryneſſe, hardneſſe, and compactedneſſe, muſt be the properties

properties which render a body impenetrable. And accordingly we see, that if a diaphanous body (which suffereth light to run through it) be much compressed beyond what it was; as when water is compressed into yce; it becometh more visible, that is, reflecteth more light: and consequently, it becometh more white; for white is that which reflecteth most light.

On the contrary side, softnesse, unctuousnesse, and viscousnesse, encreaseth blacknesse: as you may experience in oyling or in greasing of wood; which before was but brown, for thereby it commeth more black; by reason that the unctuous parts added unto the other, do more easily then they single, admit into them the light that striketh upon them; and when it is gotten in, it is so entangled there (as though the wings of it were birdlimed over) that it cannot fly out againe. And thus it is evident, how the origine of all colours in bodies, is plainly deduced out of the various degrees of rarity and density, variously mixed and compounded.

5. Why some bodies are Diaphanous, others opacous.

Likewise, out of this discourse, the reason is obvious why some bodies are diaphanous and others are opacous: for fithence it falleth out in the constitution of bodies that one is composed of greater parts then another: it must needs happen that light be more hindred in passing through a body composed of bigger parts, then an other whose parts are lesse. Neither doth it import that the pores be supposed as great as the parts, for be they never so large, the corners of the thicke parts they belong unto, must needs break the course of what will not bow, but goeth all in straight lines; more then if the parts and pores were both lesser; since, for so subtile a piercer as light, no pores can be too little to give it entrance. It is true such great ones would better admit a liquid body into them, such a one as water or ayre; but the reason of that is, because they will bow and take any ply, to creep into those cavities, if they be large enough, which light will not do.

Therefore it is cleare, that freedome of passage can happen unto light, only there, where there is an extreame great multitude of pores and parts in a very little quantity or bulke of body (which pores and parts most consequently be extream little ones) for, by reason of their multitude, there must be great variety in their situation: from whence it will happen that many

many lines must be all of pores quite through; and many others all of parts; although the most will be mixed of both pores and parts. And so we see that although the light do passe quite through in many places, yet it reflecteth from more, not onely in the superficies, but in the very body it self of the Diaphanous substance. But in another substance of great parts, and pores, there can be but few whole lines of pores, by which the light may passe from the object to make it be seen, and consequently it must be opacous; which is the contrary of Diaphanous that admitteth many rayes of light, to passe through it from the object to the eye, whereby it is seen, though the Diaphanous hard body do intervene between them.

6 The former doctrin of colours confirmed by the generation of white and black in bodies.

Now if we consider the generation of these two colours (white and black) in bodies, we shall finde that likewise to justify and second our doctrin: for white things are generally cold and dry; and therefore are by nature ordained to be receptacles, and conservers of heat, and of moysture; as Physicians do note. Contrariwise, black, as also green, (which is near of kin to black) are growing colours, and are the die of heat incorporated in aboundance of wet: as we see in smoak, in pitcoal, in garden ground, and in chymicall putrefactions all which are black; as also in yong herbs; which are generally green as long as they are yong and growing. The other colours keeping their standing betwixt these are generated by the mixture of them; and according as they partake more or lesse of either of them, are nearer or further off from it.

So that after all this discourse, we may conclude in short, that the colour of a body, is nothing else, but the power which that body hath of reflecting light unto the eye, in a certain order and position: and consequently, is nothing else but the very superficies of it, with its asperity, or smoothnesse; with its pores, or inequalities; with its hardnesse, or softnesse; and such like. The rules and limits whereof, if they were duly observed and ordered, the whole nature and science of colours would easily be known and be described. But out of this little which we have delivered of this subject it may be rightly inferred that real colours do proceed from rarity and density, (as even now we touched) and have their head & spring there: and are not strange

qualities in the Ayr; but are tractable bodies on the earth, as all others are, which as yet we have found and have meddied withall: and are indeed, the very bodies themſelves, cauſing ſuch effects upon our eye by reflecting of light, which we expreſſe by the names of colours.

THE THIRTIETH CHAP.

Of luminous or apparent Colours.

1 Apparitions of colours through a priſme or triangular glaſs are of two ſorts.

AS for the luminous colours, whoſe natures art hath made more maniable by us, than thoſe which are called reall colours, and are permanent in bodies, their generation is clearly to be ſeen in the priſme or triangular glaſſe we formerly mentioned. The conſidering of which, will confirm our doctrin, that even the colours of bodies, are by various mixtures of light and ſhadowes, diverſly reflected to our eyes. For the right underſtanding of them, we are to note, that this glaſſe maketh apparitions of colours in two ſorts: the one, when looking through it there appear various colours in the objects you look upon (different from their reall ones) according to the poſition you hold the glaſſe in when you look upon them. The other ſort is, when the beames of light that paſſe through the glaſſe are as it were tincted in their paſſage, and are caſt by the glaſſe upon ſome ſolid obiect, and do appear there in ſuch and ſuch colours, which do continue ſtill the ſame, in what poſition ſoever you ſtand to look upon them; either before, or behind, or any ſide of the glaſſe.

2 The ſeverall parts of the obiect make ſeveral angles at the entrance into the priſme.

Secondly, we are to note that theſe colours are generally made by refraction (though ſometimes it may happen otherwiſe, as above we have mentioned.) To diſcover the reaſon of the firſt ſort of colours, that appear by refraction when one looketh through the glaſſe: let us ſuppoſe two ſeverall bodies, the one black, the other white, lying cloſe by one an other, and in the ſame horizontall parallel; but ſo, that the black be further from us than the white; then, if we hold the priſme through which we are to ſee theſe two oppoſitely coloured bodies ſomewhat

what above them; and that ſide of it at which the coloured bodies muſt enter into the glaſſe to come to our eye, parallele unto thoſe bodies; it is evident, that the black will come into the priſme by leſſer angles than the white: I mean that in the line of diſtance from that face of the glaſſe at which the colours do come in, a longer line or part of black will ſubtend an angle, no bigger than a leſſer line or part of white doth ſubtend.

Thirdly, we are to note, that from the ſame point of the object, there come various beames of light to that whole ſuperficies of the glaſſe; ſo that it may, and ſometimes doth happen, that from the ſame part of the object, beams may be reflected to the eye, from ſeverall parts of that ſuperficies of the glaſſe at which they enter. And whenſoever this happeneth, the object muſt neceſſarily be ſeen in divers parts: that is, the picture of it will at the ſame time appear to the eye in divers places. And particularly, we may plainly obſerve two pictures, one a lively & ſtrong one, the other a faint and dim one. Of which the dim one will appear neerer us, than the lively one ſand is cauſed by a ſecondary ray: or rather I ſhould ſay, by a longer ray, that ſtriking neerer to the hither edge of the glaſſes ſuperficies (which is the furtheſt from the object) maketh a more acute angle than a ſhorter ray doth, that ſtriketh upon a part of the glaſſe further from our eye, but neerer the object. And therefore the image which is made by this ſecondary or longer ray, muſt appear both neerer and more dusky, than the image made by the primary and ſhorter ray. And the further from the object that the glaſſe through which it reflecteth is ſituated (keeping ſtill in the ſame parallele to the horizon) the further the place where the ſecond dusky picture appeareth, is from the place where the primary ſtrong picture appeareth.

3. The reaſon why ſometimes the ſame object appeareth through the priſme in two places; & in one place more lively, in the other place more dim.

If any man have a mind to ſatisfy himſelf by experience of the truth of this note, let him place a ſheet of white paper upon a black carpet covering a table, ſo as the paper may reach within two or three fingers of the edge of the carpet, (under which, let there be nothing to ſucceed the black of the carpet, but the empty dusky Ayre) and then let him ſet himſelf at a convenient diſtance, (the meaſure of which is, that the paper appear at his feet, when he looketh through the glaſſe) and

look at the paper through his priſme ſituated in ſuch ſort as we have above determined, and he will perceive a whitiſh or light-ſome ſhadow proceed from the lively picture that he ſeeth of white, and ſhoot out neerer towards him than that lively picture is, and he will diſcern that it commeth into the glaſſe through a part of it neerer to his eye or face, and further from the object than the ſtrong image of the white doth. And further, if he cauſeth the neerer part of the paper to be covered with ſome thin body of a ſadder colour, this dim white vaniſheth: which it doth not if the further part of the paper be covered. Whereby it is evident, that it is a ſecondary image proceeding from the hither part of the paper.

4. The reaſon of the various colours that appeare in looking through a priſme.

Now then to make uſe of what we have ſaid to the finding out of the reaſon why the red and blew and other colours appear when one looketh through a priſme: let us proceed upon our former example, in which a white paper lyeth upon a black carpet (for, the diametrall oppoſition of thoſe colours, maketh them moſt remarkable) in ſuch ſort that there be a parcel of black on the hither ſide of the paper: and therein let us examine according to our grounds, what colours muſt appear at both ends of the paper looking upon them through the triangular glaſſe.

To begin with the furtheſt end, where the black lyeth beyond the white: we may conſider, how there muſt come from the black, a ſecondary dark miſty ſhadow (beſides the ſtrong black that appeareth beyond the paper) which muſt ſhoot towards you (in ſuch ſort as we ſaid of the whitiſh light-ſome ſhadow) and conſequently, muſt ly over the ſtrong picture of the white paper: now in this caſe, a third middling colour muſt reſult out of the mixture of theſe two extremes of black & white; ſince they come to the eye, almoſt in the ſame line, at the leaſt in lines that make ſo little a difference in their angles as it is not diſcernable.

The like whereof happeneth in Cloaths, or Stuffes, or Stockings, that are woven of divers coloured but very ſmall threds: for if you ſtand ſo far off from ſuch a piece of Stuff, that the little threds of different colours which lye immediate to one another may come together as in one line to your eye; it will appear of a middling colour, different from both thoſe that it reſulteth

reſulteth from: but if you ſtand ſo neer that each thred ſendeth rayes enough to your eye, and that the baſis of the triangle which commeth from each thred to your eye, be long enough to make at the vertex of it (which is in your eye) an angle big enough to be ſeen ſingly by it ſelf, then each colour will appear a part as it truly is.

Now the various natures of middling colours we may learn of Painters; who compoſe them upon their palettes by a like mixture of the extremes. And they tell us, that if a white colour prevail ſtrongly over a dark colour, reds and yellows reſult out of that mixture: but if black prevail ſtrongly over white, then blews, violets, and ſea-greens are made. And accordingly, in our caſe, we cannot doubt but that the primary lively picture of the white, muſt prevail over the faint dusky ſable mantle with which it commeth mingled to the eye: and doing ſo, it muſt needs make a like appearance as the Suns beams do, when reflecting from a black cloud, they fringe the edges of it with red and with yellow; and the like he doth, when he looketh through a rainy or a windy cloud: and much like hereunto, we ſhall ſee this mixture of ſtrong white with a faint ſhaddow of black, make at this brim of the paper, a fair ledge of red; which will end and vaniſh, in a more lightſome one of yellow.

But at the hither edge of the paper, where the ſecondary weak picture of white is mingled with the ſtrong black picture, in this mixture, the black is prevalent, and accordingly (as we ſaid of the mixture of the Painters colours) there muſt appear at the bottome of the paper a Lembe of deep blew: which will grow more and more lightſome, the higher it goeth: and ſo, paſſing through violet and ſea-green it will vaniſh in light, when it reacheth to the maſtering field of primary whiteneſſe, that ſendeth his ſtronger rayes by direct lines: and this tranſpoſition of the colours at the ſeverall ends of the paper ſheweth the reaſon why they appear quite contrary, if you put a black paper upon a white carpet. And therefore, we need not add any thing particularly concerning that.

And likewiſe, out of this we may underſtand, why the colours appear quite contrary (that is, red where before blew appeared; and blew, where red) if wee look upon the ſame

5. The reason why the prism in one position, may make the colours appear quite contrary to what they did, when it was in an other position.

object through the glasse in an other position or situation of it: namely, if we raise it so high, that we must look upwards to see the object; which thereby appeareth above us: whereas in the former situation, it came in through the lower superficies, and we looked down to it, and it appeared under us: for in this second case, the objects comming into the glasse by a superficies not parallel as before, but sloaping, from the objectwards; it followeth, that the neerer the object is, the lesser must the angle be, which it maketh with the superficies; contrary to what happened in the former case: and likewise, that if from one point of the neerer object, there fall two rayes upon the glasse, the ray that falleth uppermost, will make a lesser angle, than the other that falleth lower; and so, by our former discourse, that point may come to appear in the same place with a point of the further object; and thereby make a middling colour.

So that in this case, the white which is neerer, will mingle his feeble picture with the black that is further off: whereas before the black that was further off, mingled his feeble shaddow with the strong picture of the neerer white. Wherefore by our rule we borrowed of the Painters, there will now appear a blew on the further end of the paper, where before appeared a red; and by consequence on the neerer end a red will now appear, where in the former case a blew appeared. This case we have chosen, as the plainest to shew the nature of such colours: out of which, he that is curious, may derive his knowledge to other cases which we omit; because our intent is onely to give a generall doctrine, and not the particulars of the Science: and rather to take away admiration, than to instruct the Reader in this matter.

6. The reason of the various colours in general by pure light passing through a prisme.

As for the various colours, which are made by straining light through a glasse, or through some other Diaphanous body; to discover the causes and variety of them, we must examine what things they are that do concurre to the making of them: and what accidents may arrive unto those things, to vary their product. It is clear, that nothing interveneth or concurreth to the producing of any of these colours, besides the light it self which is dyed into colour, and the glasse or Diaphanous body through which it passeth. In them therefore, and in nothing else, we are to make our enquiry.

To

To begin then, we may obſerve, that light paſſing through a priſme, and being caſt upon a reflecting object, is not alwayes colour; but in ſome circumſtances it ſtill continueth light, and in others it becommeth colour. Withall we may obſerve, that thoſe beames which continue light, and endure very little mutation by their paſſage, making as many refractions, do make much greater deflexions from the ſtraight lines by which they came into the glaſſe, than thoſe rayes do which turn to colour; as you may experience, if you oppoſe one ſurface of the glaſſe prependicularly to a Candle, and ſet a paper (not irradiated by the candle) oppoſite to one of the other ſides of the glaſſe: for upon the paper, you ſhall ſee fair light ſhine without any colour: and you may perceive, that the line by which the light commeth to the paper, is almoſt prependicular to that line by which the light commeth to the Priſme. But when light becommeth colour, it ſtriketh very obliquely upon the ſide of the glaſſe; and commeth likewiſe, very obliquely out of the other, that ſendeth it in colour upon a reflectent body; ſo that in concluſion, there is nothing left us whereupon to ground the generation of ſuch colours, beſides the littleneſſe of the angle and the ſloapingneſs of the line, by which the illuminant ſtriketh one ſide of the glaſſe, and commeth out at the other, when colours proceed from ſuch a percuſſion.

To this then we muſt wholly apply our ſelves: and knowing that generally, when light falleth upon a body with ſo great a ſloaping or inclination, ſo much of it as getteth through, muſt needs be weak and much diffuſed; it followeth that the reaſon of ſuch colours, muſt neceſſarily conſiſt in this diffuſion and weakeneſſe of light; which the more it is diffuſed, the weaker it groweth, and the more lines of darkneſs are between the lines of light, and do mingle themſelves with them.

To confirm this you may obſerve, how juſt at the egreſſe from the priſme of that light which going on a little further becommeth colours, no colour at all appeareth upon a paper oppoſed cloſe to the ſide of the glaſs; until removing it further off, the colours begin to ſhew themſelves upon the edges: thereby convincing mainifeſtly, that it was the exceſſe of light which hindred them from appearing at the firſt. And in like manner, if you put a burning glaſſe between the light and the priſme,

so as to multiply the light which goeth through the prisme to the paper, you destroy much of the colour by converting it into light. But on the other side, if you thicken the ayr, and make it dusky with smoak, or with dust, you will plainly see, that where the light commeth through a convex glasse (perpendicularly opposed to the illuminant) there will appear colours on the edges of the cones that the light maketh: and peradventure the whole cones would appear coloured if the darkning were conveniently made: for if an opacous body be set within either of the cones, its sides will appear coloured, though the ayr be but moderately thickned: which sheweth that the addition of a little darkenesse, would make that which otherwise appeareth pure light, be throughly dyed into colours. And thus you have the true and adequate cause of the appearance of such colours.

7 Upon what side every colour appeareth that is made by pure light passing thorow a prism.

Now, to understand what colours, and upon which sides, will appear: we may consider, that when light passeth through a glasse, or other diaphanous body, so much of it as shineth in the ayr, or upon some reflecting body bigger than it self, after its passage through the glasse, must of necessity have darknesse on both sides of it; and so be compriled and limited by two darknesses: but if some opacous body, that is lesse than the light, be put in the way of the light, then it may happen contrariwise, that there be darknesse (or the shadow of that opacous body) between two lights.

Again, we must consider, that when light falleth so upon a prisme as to make colours, the two outward rayes which proceed from the light to the two sides of the superficies at which the light entereth, are so refracted, that at their comming out again through the other superficies, that ray which made the lesse angle with the outward superficies of the glasse, going in, maketh in the greater angle with the outside of the other superficies, comming out: and contrariwise, that ray which made the greater angle, going in, maketh the lesser at its comming out: and the two internall angles, made by those two rayes, and the outside of the superficies they issue at, are greater than two right angles: and so we see that the light dilateth it self at its comming out.

Now because rayes that issue through a superficies, the nearer they

they are to be perpendiculars unto that superficies, so much the thicker they are: it followeth, that this dilatation of light at its comming out of the glasse, must be made and must increase from that side where the angle was least at the going in, and greatest at the comming out: so that the nearer to the contrary side you take a part of light, the thinner the light must be there, and contrariwise, the thicker it must be, the nearer it is unto the side where the angle at the rayes comming out is the greater. Wherefore, the strongest light, (that is, the place where the light is least mixed with darkness) must be nearer that side than the other. Consequently hereunto, if by an opacous body you make a shadow comprehended within this light, that shadow must also have its strongest part, nearer unto one of the lights betwixt which it is comprised, than unto the other: for, shadow being nothing else, but the want of light, hindred by some opacous body; it must of necessity lie averted from the illuminant, just as the light would have lain if it had not been hindred. Wherefore, seeing that the stronger side of light, doth more impeach the darkness, than the feebler side doth; the deepest dark must incline to that side, where the light is weakest; that is, towards that side on which the shadow appeareth, in respect of the opacous body, or of the illuminant, and so be a cause of deepnesse of colour on that side, if it happen to be fringed with colour.

THE ONE AND THIRTIETH CHAPTER.

The causes of certain apparances in luminous colours; with a conclusion of the discourse touching the senses and the sensible qualities.

The reason of each severall colour in particular caused by light passing through a prism.

OUt of these grounds we are to seek the resolution of all such symptoms as appear unto us in this kind of colours. First therefore calling to mind, how we have already declared, that the red colour is made by a greater proportion of light mingled with darkness, and the blew with a lesse proportion: it must follow, that when light passeth through a glasse in such sort as to make colours, the mixture of the light and darkness on that side where the light is strongest will encline to a red:

red: and their mixture on the other ſide, where the light is weakeſt, will make a violet or blew: and this we ſee to fall out accordingly, in the light which is tincted by going through a priſme; for a red colour appeareth on that ſide from which the light doth dilate or encreaſe, and a blew is on that ſide towards which it decreaſeth.

Now if a dark body be placed within this light, ſo as to have the light come on both ſides of it, we ſhall ſee the contrary happen about the borders of the picture or ſhadow of the dark body: that is to ſay, the red colour will be on that ſide of the picture which is towards or over againſt the blew colour that is made by the glaſſe: and the blew of the picture will be on that ſide which is towards the red that is made by the glaſſe, as you may experience if you place a ſlender opacous body along the priſme in the way of the light, either before or behind the priſme. The reaſon whereof is, that the opacous body ſtanding in the midle, environed by light, divideth the light, and maketh two lights of that which was but one; each of which lights is compriſed between two darkneſſes, to wit, between each border of ſhadow that joyneth to each extream of the light that cometh from the glaſſe, and each ſide of the opacous bodies ſhadow. Wherefore, in each of theſe lights, or rather in each of their commixtions with darkneſſe, there muſt be red on the one ſide and blew on the other; according to the courſe of light which we have explicated.

And thus it falleth out, agreeable to the rule we have given, that blew commeth to be on that ſide of the opacous bodies ſhadow on which the glaſs caſteth red, and red on that ſide of it on which the glaſs caſteth blew: likewiſe when light going through a convexe glaſſe maketh two cones, the edges of the cone betwixt the glaſſe and the point of concurſe will appear red, if the room be dark enough: and the edges of the further cone, will appear blew, both for the reaſon given: for in this caſe the point of concurſe is the ſtrong light betwixt the two cones: of which, that betwixt the glaſſe and the point is the ſtronger, that beyond the point the weaker: and for this very reaſon, if an opacous body be put in the axis of theſe two cones, both the ſides of its picture will be red, if it be held in the firſt cone which is next to the glaſſe; and both will be blew if the body be ſituated

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in the further cone; for both ſides being equally ſituated to the courſe of the light, within its own cone, there is nothing to vary the colours, but onely the ſtrength and the weakneſſe of the two lights of the cones, on this ſide and on that ſide the point of concurſe: which point, being in this caſe the ſtrong and clear light whereof we made generall mention in our precedent note, the cone towards the glaſſe and the illuminant, is the ſtronger ſide, and the cone from the glaſſe, is the weaker.

In thoſe caſes, where this reaſon is not concerned, we ſhall ſee the victory carried in the queſtion of colours, by the ſhady ſide of the opacous body: that is, the blew colour wil ſtill appear on that ſide of the opacous bodies ſhaddow that is furtheſt from the illuminant. But where both cauſes do concurre and contraſt for precedence, there the courſe of the light carrieth it: that is to ſay, the red will be on that ſide of the opacous bodies ſhadow where it is thicker and darker, and blew on the other ſide where the ſhadow is not ſo ſtrong; although the ſhadow be caſt that way that the red appeareth: as is to be ſeen, when a ſlender body is placed betwixt the priſme and the reflectent body, upon which the light and colours are caſt through the priſme: and it is evident, that this cauſe of the courſe of the ſhadow, is in it ſelf a weaker cauſe, than the other of the courſe of light, and muſt give way unto it whenſoever they encounter (as it cannot be expected, but that in all circumſtances, ſhadows ſhould be light) becauſe the colours which the glaſſe caſteth in this caſe, are much more faint and dusky than in the other.

For effects of this latter cauſe, we ſee that when an opacous body lyeth croſs the priſme, whiles it ſtandeth end-wayes, the red or blew colour will appear on the upper or lower ſide of its picture, according as the illuminant is higher or lower than the tranſverſe opacous body: the blew ever keeping to that ſide of the picture, that is furtheſt from the body, and the illuminant that make it: and the red the contrary; likewiſe if an opacous body be placed out of the axis, in either of the cones we have explicated before, the blew wil appear on that ſide of the picture which is furtheſt advanced in the way that the ſhaddow is caſt: and the red, on the contrary: and ſo, if the opacous body be placed in the firſt cone (beſide the axis) the red will appear on that ſide of the picture in the baſis of the ſecond cone, which

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is next to the circumference; and the blew, on that side which is next the axis: but if it be placed on one side of the axis in the second cone, then the blew will appear on that side the picture which is next the cicumference, and the red, on that side which is next the center of the basis of the cone.

2 A difficult probleme resolved touching the prisme

There remaineth yet one difficulty of moment to be determined: which is, why when through a glasse, two colours (namely, blew and red) are cast from a candle upon a paper or wall, if you put your eye in the place of one of the colours that shineth upon the wall, and so that colour commeth to shine upon your eye, in such sort that another man who looketh upon it, will see that colour plainly upon your eye, nevertheless, you shall see the other colour in the glasse? As for example, if on your eye there shineth a red, you shall see a blew in the glasse, and if a blew shineth upon your eye, you shall see a red.

The reason hereof is, that the colours which appearing the glasse, are of the nature of those luminous colours which we first explicated, that arise from looking upon white and black bordering together: for a candle standing in the ayr, is as it were a white situated between two blacks: the circumstant dusky Ayr, having the nature of a black: so then, that side of the candle which is seen through the thicker part of the glasse, appeareth red; and that which is seen through the thinner, appeareth blew: in the same manner as when we look through the glasse; whereas the colours shine contrarywise upon a paper or reflecting object, as we have already declared, together with the reasons of both these appearances; each fitted to its proper case, of looking through the glasse upon the luminous object surrounded with darkenesse, in the one; and of observing the effect wrought by the same luminous object in some medium or upon some reflectent superficies, in the other.

And to confirm this, if a white paper be set standing hollow before the glasse (like half a hollow pillar, whose flat standeth edgewaies towards the glasse, so as both the edges may be seen through it) the further edge will seem blew, and the neerer will be red, and the like will happen, if the paper be held in the free ayr parallel to the lower superficies of the glasse, without any black carpet to limit both ends of it (which serveth to make the colours the smarter) so that in both cases, the ayr serveth manifestly

fectly for a black; in the first, between the two white edges; and in the second, limiting the two white ends; and by consequence, the ayr about the candle must likewise serve for two blacks, including the light candle between them.

Several other delightfull experiments of luminous colours I might produce, to confirm the grounds I have layd, for the nature and making of them. But I conceived that these I have mentioned, are abundantly enough for the end I propose unto my self: therefore I will take my leave of this supple and nice subject; referring my Reader (if he be curious to entertain himself with a full variety of such shining wonders) to our ingenious Countrey-man, and my worthy friend, Mr. Hall: who at my last being at Liege, shewed me there most of the experiences I have mentioned, together with severall other very fine and remarkable curiosities concerning light; which he promised me he would shortly publish in a work, that he had already cast and almost finished upon that subject: and in it, I doubt not but he will give entire satisfaction to all the doubts and Problemes that may concur in this subject: whereas my little exercise formerly in making experiments of this kind, and my lesse conveniency of attempting any now, maketh me content my self with thus spinning of a coarse thred from woold carded me by others, that may run through the whole doctrine of colours, whose causes have hitherto been so much admired: & that it will do so, I am strongly perswaded, both because if I look upon the causes which I have assigned *à priore*, me thinkes they appear very agreeable to nature and to reason; and if I apply them to the severall Phænomens which Mr. Hall shewed me, and to as many others, as I have otherwise met with, I finde they agree exactly with them, and render a full account of them.

And thus you have the whole nature of luminous colours resolved into the mixtion of light and darknes: by the due ordering of which, who have skill therein, may produce any middle colour he pleaseth, as I my selfe have seen the experince of infinite changes in such sort made; so that it seemeth unto me, nothing can be more manifest, than that luminous colours are generated in the way that is here delivered. Of which how that gentle, and obedient Philosophy of *Aristotle* (readily obedient to what hard task soever you assign it) will render a rationall account;

is next to the circumference; and the blew, on that ſide which is next the axis: but if it be placed on one ſide of the axis in the ſecond cone, then the blew will appear on that ſide the picture which is next the cicumference, and the red, on that ſide which is next the center of the baſis of the cone.

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There remaineth yet one difficulty of moment to be determined: which is, why when through a glaſſe, two colours (namely, blew and red) are caſt from a candle upon a paper or wall, if you put your eye in the place of one of the colours that ſhineth upon the wall, and ſo that colour commeth to ſhine upon your eye, in ſuch ſort that another man who looketh upon it, will ſee that colour plainly upon your eye, nevertheleſſe, you ſhall ſee the other colour in the glaſſe? As for example, if on your eye there ſhineth a red, you ſhall ſee a blew in the glaſſe, and if a blew ſhineth upon your eye, you ſhall ſee a red.

The reaſon hereof is, that the colours which appearing the glaſſe, are of the nature of thoſe luminous colours which we firſt explicated, that ariſe from looking upon white and black bordering together: for a candle ſtanding in the ayr, is as it were a white ſituated between two blacks: the circumſtant dusky Ayr, having the nature of a black: ſo then, that ſide of the candle which is ſeen through the thicker part of the glaſſe, appeareth red; and that which is ſeen through the thinner, appeareth blew: in the ſame manner as when we look through the glaſſe; whereas the colours ſhine contrarywiſe upon a paper or reflecting object, as we have already declared, together with the reaſons of both theſe appearances; each referred to its proper caſe, of looking through the glaſſe upon the luminous object ſurrounded with darkneſſe, in the one; and of obſerving the effect wrought by the ſame luminous object in ſome medium or upon ſome reflectent ſuperficies, in the other.

And to confirm this, if a white paper be ſet ſtanding hollow before the glaſſe (like half a hollow pillar, whoſe flat ſtandeth edgewaies towards the glaſſe, ſo as both the edges may be ſeen through it) the further edge will ſeem blew, and the neerer will be red, and the like will happen, if the paper be held in the free ayr parallel to the lower ſuperficies of the glaſſe, without any black carpet to limit both ends of it (which ſerveth to make the colours the ſmarter) ſo that in both caſes, the ayr ſerveth manifeſtly

feitly for a Black; in the first, between the two white edges; and in the second, limiting the two white ends; and by consequence, the ayr about the candle must likewise serve for two blacks, including the light candle between them.

Several other delightfull experiments of luminous colours I might produce, to confirm the grounds I have layd, for the nature and making of them. But I conceived that these I have mentioned, are aboundantly enough for the end I propose unto my self: therefore I will take my leave of this supple and nice subject; referring my Reader (if he be curious to entertain himself with a full variety of such shining wonders) to our ingenious Countrey-man, and my worthy friend, Mr. Hall: who at my last being at Liege, shewed me there most of the experiences I have mentioned, together with severall other very fine and remarkable curiosities concerning light; which he promised me he would shortly publish in a work, that he had already cast and almost finished upon that subject: and in it, I doubt not but he will give entire satisfaction to all the doubts and Problemes that may concur in this subject: whereas my little exercise formerly in making experiments of this kind, and my lesse conveniency of attempting any now, maketh me content my self with thus spinning of a coarse thred from woll carded me by others, that may run through the whole doctrine of colours, whose causes have hitherto been so much admired: & that it will do so, I am strongly perswaded, both because if I look upon the causes which I have assigned *à priore*, me thinkes they appear very agreeable to nature and to reason; and if I apply them to the severall Phænomens which Mr. Hall shewed me, and to as many others, as I have otherwise met with, I finde they agree exactly with them, and render a full account of them.

And thus you have the whole nature of luminous colours resolved into the mixtion of light and darkness: by the due ordering of which, who have skill therein, may produce any middle colour he pleaseth, as I my selfe have seen the experince of infinite changes in such sort made; so that it seemeth unto me, nothing can be more manifest, than that luminous colours are generated in the way that is here delivered. Of which how that gentle, and obedient Philosophy of *Polities* (readily obedient to what hard task soever you assign it) will render a rationall account;

is next to the circumference; and the blew, on that side which is next the axis: but if it be placed on one side of the axis in the second cone, then the blew will appear on that side the picture which is next the circumference, and the red, on that side which is next the center of the basis of the cone.

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The reason hereof is, that the colours which appearing the glasse, are of the nature of those luminous colours which we first explicated, that arise from looking upon white and black bordering together: for a candle standing in the ayr, is as it were a white situated between two blacks: the circumstant dusky Ayr, having the nature of a black: so then, that side of the candle which is seen through the thicker part of the glasse, appeareth red; and that which is seen through the thinner, appeareth blew: in the same manner as when we look through the glasse; whereas the colours shine contrarywise upon a paper or reflecting object, as we have already declared, together with the reasons of both these appearances; each fitted to its proper case, of looking through the glasse upon the luminous object surrounded with darkneſſe, in the one; and of observing the effect wrought by the same luminous object in some medium or upon some reflectent superficies, in the other.

And to confirm this, if a white paper be set standing hollow before the glasse (like half a hollow pillar, whose flat standeth edgewaies towards the glasse, so as both the edges may be seen through it) the further edge will seem blew, and the nearer will be red, and the like will happen, if the paper be held in the free ayr parallel to the lower superficies of the glasse, without any black carpet to limit both ends of it (which serveth to make the colours the smarter) so that in both cases, the ayr serveth manifestly

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And thus you have the whole nature of luminous colours resolved into the mixtion of light and darkness: by the due ordering of which, who have skill therein, may produce any middle colour he pleaseth, as I my selfe have seen the experince of infinite changes in such sort made; so that it seemeth unto me, nothing can be more manifest, than that luminous colours are generated in the way that is here delivered. Of which how that gentle, and obedient Philosophy of *Aristotle* (readily obedient to what hard task soever you assign it) will render a rationall account;

account; and what diſcreet vertue, it will give the ſame things to produce different colours, and to make different appearances, meerely by ſuch nice changes of ſituation, I do not well underſtand: but peradventure the Patrons of it, may ſay that every ſuch circumſtance is a *Conditio ſine qua non*: and therewith (no doubt) their Auditors will be much the wiſer in comprehending the particular nature of light, and of the colours that have their origine from it.

3 Of the Rainbow, and how by the colour of any body we may know the compoſition of the body it ſelfe

The Rainbow, for whoſe ſake moſt men handle this matter of luminous colours, is generated in the firſt of the two wayes we have delivered or the production of ſuch colours: and hath its origine from refraction, when the eye being at a convenient diſtance from the refracting body, looketh upon it to diſcern what appeareth in it. The ſpeculation of which, may be found in that excellent diſcourſe of *Mounſeur des Cartes*, which is the ſixt of his Meteors; where he hath with great accurateneſſe delivered a moſt ingenious doctrine of this myſtery: had not his bad chance of miſſing in former principles (as I conceive) ſomewhat obſcured it. For he there giveth the cauſe ſo near, and ſo juſtly calculated to the appearances, as no man can doubt but that he hath found out the true reaſon of this wonder of nature, which hath perplexed ſo many great wits: as may almoſt be ſeen with our very eyes; when looking upon the freſh deaw in a Sunſhiny morning, we may in due poſitions perceive the rainbow colours, not three yards diſtant from us: in which we may diſtinguiſh even ſingle drops with their effects. But he having determined the nature of light to conſiſt in motion, and proceeding conſequently, he concludeth colours to be but certain kinds of motion; by which I fear it is impoſſible that any good account ſhould be given of the experiences we ſee.

But what we have already ſaid in that point, I conceive is ſufficient to give the Reader ſatisfaction therein: and to ſecure him, that the generation of the colours in the Rainbow, as well as all other colours, is likewiſe reduced to the ming'ling of light and darkneſſe: which is our principall intent to prove: adding thereunto by way of advertiſement, for others whoſe leiſure may permit them to make uſe thereof, that who ſhall ba'lance the proportions of luminous colours may peradventure make himſelfe a ſtep to judge of the natures of thoſe bodies, which really

really and constantly do wear like dyes; for, the figures of the least parts of such bodies, joyntly with the connexion or mingling of them with pores, must of necessity be that which maketh them reflect light unto our eyes, in such proportions, as the luminous colours of their tincture and semblance do.

For two things are to be considered in bodies, in order to reflecting of light: either the extancies or the cavities of them; or their hardnesse and softnesse. As for the first; the proportions of light mingled with darknesse will be varied, according as the extancies or the cavities do exceed, and as each of them is great or small: since cavities have the nature of darknesse, in respect of extancies, as our modern Astronomers do shew, when they give account of the face (as some call it) in the orb of the Moon. Likewise in regard of soft or of resistent parts, light will be reflected by them, more or lesse strongly, that is, more or lesse mingled with darknesse; for whereas it rebounderh smartly back if it striketh upon a hard and resistent body, and accordingly will shew it self in a bright colour: it must of necessity not reflect at all, or very feebly, if it penetrateth into a bodie of much humidity, or if it loseth it self in the pores of it; and that little which commeth so weakly from it, must consequently appear of a dusky die: and these two being all the causes of the great variety of colours we see in bodies according to the quality of the body, in which the real colour appeareth, it may easily be determined from which of them it proceedeth: and then by the colour, you may judge of the composition and mixture of the rare and dense parts, which by reflecting light begetteth it.

4 That all the sensible qualities are real bodies resulting out of several mixtures of rarity and density.

In fine, out of all we have hitherto said in this Chapter, we may conclude the primary intent of our so long discourse: which is, that as well the senses of living creatures, as the sensible qualities in bodies are made by the mixtion of rarity and density, as well as the natural qualities we spoke of in their place: for it cannot be denied but that heat and cold, and the other couples or paires, which beat upon our touch, are the very same as we see in other bodies: the qualities which move our taste and smell, are manifestly akin and joyned with them: light we have concluded to be fire: and of motion (which affecteth our eare) it is not disputable: so that it is evident, how all sensible qualities,

qualities, are as truely bodies, as those other qualities which we call naturall.

To this we may adde, that the properties of these sensible qualities are such as proceed evidently from rarity and density: for (to omit those which our touch taketh notice of, as too plain to be questioned) Physicians judge and determine the naturall qualities of meats, and of medicines, and of simples by their tastes and smels: by those qualities they finde out powers in them to do materiall operations; and such as our instruments for cutting, filing, brushing, and the like, do unto ruder and grosser bodies. All which vertues, being in these instruments by the different tempers of rarity and density, is a convincing argument, that it must be the same causes, which must produce effects of the same kind in their smels and tasts: and as for light, it is known how corporeally it worketh upon our eyes.

Again, if we look particularly into the composition of the organs of our senses, we shal meet with nothing but such qualities as we finde in the composition of all other naturall bodies. If we search into our eye, we shall discover in it nothing but diaphaneity, softnesse, divers colours, and consistencies; which all Anatomists, to explicate, do parallell in other bodies: the like is of our tongue, our nosethrills, and our eares. As for our touch, that is so material a sense, and so diffused over the whole body, we can have no difficulty about it. Seeing then that all the qualities we can discover in the organs of our senses are made by the various minglings of rarity with density, how can we doubt, but that the active powers over these patients, must be of the same nature and kind?

Again, seeing that examples above brought, do convince, that the objects of one sense, may be known by another; who can doubt of a community among them, if not of degree, at the least of the whole kind? As we see that the touch is the groundwork of all the rest; and consequently, that being evidently corporeal and consisting in a temper of rarity and density, why should we make difficulty in allowing the like of the rest?

Besides, let us compose of rarity and density, such tempers as we finde in our senses; and let us again compose of rarity and density, such actors, as we have determined the qualities, which we call sensible, to be; and will it not manifestly follow, that these

theſe two applyed to one another, muſt produce ſuch effects, as we affirm our ſenſes have? that is, to paſſe the outward objects, by different degrees, unto an inward receiver.

Againe, let us caſt our eyes upon the naturall reſolution of bodies, and how they move us, and we ſhall thereby diſcover, both what the ſenſes are, and why they are juſt ſo many, and that they cannot be more. For an outward body may move us, either in its own bulk or quantity; or as it worketh upon another. The firſt is done by the touch, the ſecond by the ear, when a body moving the ayr, maketh us take notice of his motion. Now in reſolution, there are three active parts proceeding from a body, which have power to move us. The fiery part, which you ſee, worketh upon our eyes by the vertue of light. The ayrie part, which we know moveth our noſethrils, by being ſucked in with the ayr. And laſtly the ſalt, which diſſolveth in water, and ſo moveth our watry ſenſe; which is our taſt.

§. Why the ſenſes are onely five in number: with a concluſion of all the former doctrine concerning them.

And theſe being all the active parts, that ſhew themſeves in the reſolution of a body; how can we imagine there ſhould be any more ſenſes to be wrought upon? for what the ſtable body ſheweth of it ſelf, will be reduced to the touch: what, as it moveth, to hearing: what the reſolutions of it, according to the natures of the reſolved atomes that fly abroad, will concern the other three ſenſes, as we have declared. And more wayes of working, or of active parts, we cannot conceive to ſpring out of the nature of a body.

Finally, if we caſt our eyes upon the intention of nature: to what purpoſe are our ſenſes, but to bring us into knowledge of the natures of the ſubſtances we converſe withall? ſurely, to effect this, there cannot be invented a better, or more reaſonable expedient, than to bring unto our judgement-ſeat the likeneſſes or extracts of thoſe ſubſtances, in ſo delicate a modell, that they may not be offenſive or cumberſome; like ſo many patterns preſented unto us, to know by them, what the whole piece is: for all ſimilitude is a communication between two things in that quality, wherein their likeneſſe conſiſteth: and therefore we cannot doubt, but that nature hath given us by the means we have explicated, an eſſay to all the things in the world, that fall under our commerce, whereby to judge whether they be profitable or notive unto us; and yet in ſo delicate and

ſubtile a quantity, as may in no waies be offenſive to us, whiles we take our meaſures to attract what is good, and avoyd what is noxious.

THE TWO AND THIRTIETH CHAPTER.

Of ſenſation, or the motion whereby ſenſe is properly exerciſed.

1. Mounſieur des Cartes his opinion touching ſenſation.

OUT of the conſiderations which we have delivered in theſe laſt Chapters, the Reader may gather the unreaſonableneſſe of vulgar Phyloſophers, who to explicate life and ſenſe, are not content to give us termes without explicating them; but will force us to believe contradictions: telling us, that life conſiſted in this, that the ſame thing hath a power to work upon it ſelf: and that ſenſation, is a working of the active part of the ſame ſenſe, upon its paſſive part; and yet will admit no parts in it: but will have the ſame indiviſible power to work upon it ſelf. And this, with ſuch violence and down-bearing of all oppoſition, that they deem him not conſiderable in the ſchools, who ſhall offer onely to doubt, of what they teach him hereabout; but brand him with the cenſure of one who knoweth not, and contradicteth the very firſt principles of Phyloſophy. And therefore, it is requiſite that we ſhould look ſomewhat more particularly into the manner how ſenſation is made.

Mounſieur des Cartes (who by his great and heroike attempts, and by ſhewing mankind how to ſteer and husband their reaſon to beſt advantage, hath left us no excuſe for being ignorant of any thing worth the knowing) explicating the nature of ſenſe, is of opinion, that the bodies without us, in certain circumſtances, do give a blow upon our exterior organs: from whence, by the continuity of the parts, that blow or motion is continued, till it come to our brain and ſeat of knowledge; upon which it giveth a ſtroke anſwerable to that, which the outward ſenſe firſt received: and there this knock cauſing a particular effect, according to the particular nature of the motion (which dependeth of the nature of the object that produceth it) our ſoul and mind hath notice by this means, of every thing

thing that knocketh at our gates: and by the great variety of knocks or motions that our brain feeleth (which riſeth from as great a variety of natures in the objects that cauſe them) we are enabled to judge of the nature and conditions of every thing we converſe withall.

As for example: he conceiveth light to be nothing elſe but a percuſſion made by the illuminant upon the ayr, or upon the ethereall ſubſtance, which he putteth to be mixed with, and to runne through all bodies: which being a continuate medium between the illuminant and our ſenſe; the percuſſion upon that, ſtriketh alſo our ſenſe; which he calleth the nerve that reacheth from the place ſtrucken (to wit, from the bottome of our eye) unto the brain. Now, by reaſon of the continuity of this ſtring or nerve, he conceiveth that the blow which is made upon the outward end of it by the ether, is conveyed by the other end of it to the brain; that end, ſtriking the brain in the ſame meaſure as the ether ſtruck the other end of it: like the jack of a Virginall, which ſtriketh the ſounding cord, according as the Muſitians hand preſſeth upon the ſtop. The part of the brain which is thus ſtrucken, he ſuppoſeth to be the fantaſie, where he deemeth the ſoul doth reſide; and thereby taketh notice of the motion and object that are without. And what is ſaid thus of ſight, is to be applied proportionably to the reſt of the ſenſes.

This than is the ſumme of Monſieur des Cartes his opinion, which he hath very finely expreſſed, with all the advantages that oppoſite examples, ſignificant words, and clear method can give unto a witty diſcourſe. Which yet is but a part of the commendations he deſerveth, for what he hath done on this particular. He is over and above all this, the firſt that I have ever met with, who had publiſhed any conceptions of this nature, whereby to make the operations of ſenſe intelligible. Certainely, this praiſe will ever belong unto him, that he hath given the firſt hint of ſpeaking groundedly, and to the purpoſe upon this ſubject, and whatſoever ſhall carry it any further (as what important myſtery was ever borne and perfected at once?) muſt acknowledge to have derived his light from him.

For my part, I ſhall ſo far agree with him, as to allow mo-

2 The Authors opinion touching ſenſation.

tion alone to be ſufficient to work ſenſation in us: and not onely to allow it ſufficient, but alſo to profeſſe, that not onely this, but that no other effect whatſoever can be wrought in us, but motion, and by means of motion. Which is evident out of what we have already delivered, ſpeaking of bodies in generall; that all action among them, either is locall motion, or elſe followeth it: and no leſſe evident, out of what we have declared in particular, concerning the operations of the out ward ſenſes, and the objects that work upon them: and therefore, whoſoever ſhall in this matter, require any thing further than a difference of motion, he muſt firſt ſeek other inſtruments in objects to cauſe it. For, examining from their very origine, the natures of all the bodies we converſe withall; we cannot finde any ground to believe they have power or meanes to work any thing beyond motion.

But I ſhall crave leave to differ from him, in determining what is the ſubiect of this motion, whereby the brain judgeth of the nature of the thing that cauſeth it. He will allow no local change of any thing in a man, further than certain vibrations of ſtrings, which he giveth the objects to play upon from the very ſenſe up to the brain: and by their different manners of ſhaking the brain, he will have it know, what kind of thing it is that ſtriketh the outward ſenſe, without removing any thing within our body from one place to another. But I ſhall go the more common way; and make the ſpirits to be the porters of all newes to the brain: onely adding thereunto, that theſe newes which they carry thither, are materiall participations of the bodies that work upon the outward organs of the ſenſes; and paſſing through them, do mingle themſelves with the ſpirits, and ſo do go whither they carry them, that is, to the brain; unto which from all parts of the body, they have immediate reſort, and a perpetuall communication with it.

So that, to exerciſe ſenſe (which our Latines do call *ſentire*, but in Engliſh we have no one word common to our ſeverall particular notions of divers perceptions by ſenſe) is, *Our brain to receive an impreſſion from the extern object by the operation or mediation of an organicall part made for that purpoſe, and ſome one of thoſe which we term an extern ſenſe; from which impreſſion, uſually floweth ſome motion proper to the living crea-*

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ture. And thus you ſee that the outward ſenſes, are not truly ſenſes, as if the power of ſenſation were in them: but in another meaning, to wit, ſo farre as they are inſtruments of qualifying or conveying the object to the braine.

Now, that the ſpirits are the inſtruments of this conveyance, is evident, by what we daily ſee, that if a man be very attentive to ſome one extern object (as to the hearing or ſeeing of ſomething that much delighteth or diſpleaſeth him) he neither heareth or ſeeth any thing, but what his mind is bent upon; though all that while, his eyes and eares be open, and ſeverall of their objects be preſent, which at other times would affect him. For what can be the reaſon of this, but that the brain employing the greateſt part of his ſtore of ſpirits about that one object, which ſo powerfully entertaineth him, the others find very few free for them to imbue with their tincture? And therefore, they have not ſtrength enough to give the brain a ſufficient taſt of themſelves, to make it be obſerved; nor to bring themſelves into a place where they may be diſtinctly diſcerned: but ſtriving to get unto it, they loſe themſelves in the throng of the others, who for that time do beſiege the brain cloſely. Whereas, in Monſieur des Cartes his way (in which no ſpirits are required) the apprehenſion muſt of neceſſity be carried preciſely according to the force of the motion of the extern object.

3 Reaſons to perſwade the authors opinion.

This argument I confeſſe, is not ſo convincing a one againſt his opinion, but that the neceſſity of the conſequence may be avoided; and another reaſon be given for this effect, in Monſieur des Cartes his doctrin: for he may ſay, that the affection being vehemently bent upon ſome one object, may cauſe the motion to be ſo violent by the addition of inward percuſſions, that the other comming from the outward ſenſe, being weaker, may be drowned by it; as leſſer ſounds are by greater, which do forcibly carry our eares their way, and do fill them ſo entirely, that the others cannot get in to be heard: or as the drawing of one man that pulleth backwards, is not felt when a hundred draw forwards. Yet this is hard to conceive, conſidering the great eminency which the preſent object hath over an abſent one, to make it ſelf be felt: whence it followeth, that the multiplication of motion muſt be extreamly encreaſed within, to overtop

and bear down the motion, caused by a present object actually working without.

But that which indeed convinceth me to beleeve I go not wrong in this course, which I have set down for extern bodies working upon our sense and knowledge: is first, the convenience, and agreeablenesse to nature, both in the objects and in us, that it should be done in that manner: and next, a difficulty in Mounsieur des Cartes his way, which me thinketh, maketh it impossible that his should be true. And then his being absolutely the best of any I have hitherto met withall, and mine supplying what his falleth short in, and being sufficient to perform the effects we see: I shall not think I do amisse in beleeving my own to be true, till some body else shew a better.

4 That vitall spirits are the immediate instrumen:s of sensation by conveying sensible qualities to the brain.

Let us examin these considerations one after another. It is manifest by what we have already established, that there is a perpetuall flux of little parts or atomes out of all sensible bodies, that are composed of the four Elements, and are here in the sphere of continuall motion by action and passion: and such i: is, that in all probability these little parts cannot chuse but get in at the doores of our bodies, and mingle themselves with the spirits that are in our nerves. Which if they do, it is unavoydable, but that of necessity they must make some motion in the brain; as by the explication we have made of our outward senses, is manifest: and the brain being the source and origin of all such motion in the animal, as is termed voluntary; this stroke of the object, will have the power to cause some variation in its motions that are of that nature: and by consequence, must be a sensation, for, that change which being made in the brain by the object, is caused of voluntary motion in the animal, is that, which we call sensation.

But we shall have best satisfaction, by considering how it fareth with every sense in particular. It is plain, that our touch or feeling is affected by the little bodies of heat, or cold, or the like, which are squeesed or evaporated from the object; and do get into our flesh, and consequently, do mingle themselves with our spirits: and accordingly, our hand is heated with the floud of subtile fire, which from a great one without, streameth into it: and is benummed with multitudes of little bodies of cold, that settle in it. All which little bodies, of heat, or of cold

cold, or of what kind ſo ever they be, when they are once got in, muſt needs mingle themſelves with the ſpirits they meet with in the nerve: and conſequently, muſt go along with them up to the brain: for the channell of the nerve being ſo little, that the moſt accurat inſpectours of natur cannot diſtinguiſh any little cavity or hole running along the ſubſtance of it: and the ſpirits which ebbe and flow in thoſe channells, being ſo infinitely ſubtil and in ſo ſmall a quantity, as ſuch channells can contain: it is evident, that an atome of inſenſible bigneſſe, is ſufficient to imbue the whole length and quantity of ſpirit that is in one nerve: and that atome, by reaſon of the ſubtilty of the liquor it is immerſed in, is preſently and as it were inſtantly, diffuſed through the whole ſubſtance of it: the ſource therefore of that liquor being in the brain, it cannot be doubted, but that the force of the extern object muſt needes affect the brain according to the quality of the ſaid atome: that is, give a motion, or knock, conformable to its own nature.

As for our taſt, it is as plain, that the little parts expreſſed out of the body which affecteth it, do mingle themſelves with the liquor, that being in the tongue, is continuate to the ſpirits: and then, by our former argument it is evident, they muſt reach unto the brain. And for our ſmelling, there is nothing can hinder odours from having immediate paſſage up to our brain, when by our noſe, they are once gotten into our head.

5 How ſound is conveyed to the brain by vitall ſpirits.

In our hearing, there is a little more difficulty: for ſound being nothing but a motion of the Ayr, which ſtriketh our eare; it may ſeem more then needeth, to ſend any corporeall ſubſtance into the brain: and that it is ſufficient, that the vibrations of the outward ayr, ſhaking the drum of the eare, do give a like motion to the ayr within the eare, that on the inſide toucheth the tympane: and ſo this ayr thus moved ſhaketh and beateth upon the brain. But this I conceive, will not ſerve the turn; for if there were no more but an actual motion, in the making of hearing; I do not ſee how ſounds could be conſerved in the memory: ſince of neceſſity, motion muſt alwayes reſide in ſome body; which argument, we ſhall preſſe anon againſt Mounſieur des Cartes his opinion for the reſt of the ſenſes.

Out of this difficulty, the very inſpection of the parts within

the ear, ſeemeth to lead us: for had there been nothing neceſſary beſides motion, the very ſtriking of the outward ayr againſt the tympanum, would have been ſufficient without any other particular and extraordinary organization, to have produced ſounds, and to have carried their motions up to the brain: as we ſee the head of a drum bringeth the motions of the earth unto our ear, when we lay it thereunto, as we have formerly delivered. But Anatomiſts finde other tools and inſtruments, that ſeem fit to work and forge bodies withall; which we cannot imagine nature made in vain. There is a Hammer and an Anvile: whereof the Hammer, ſtriking upon the Anvile, muſt of neceſſity beat off ſuch little parts of the brainy ſtreams, as flying about, do light and ſtick upon the top of the Anvile: theſe by the trembling of the Ayr, following its courſe, cannot miſſe of being carried up to that part of the brain, whereunto the Ayr within the ear is driven by the impulſe of the ſound: and as ſoon as they have given their knock, they rebound back again into the cells of the brain, fitted for harbours to ſuch winged meſſengers: where they remain lodged with quietneſſe, till they be called for again, to renew the effect which the ſound did make at the firſt: and the various blows which the Hammer ſtriketh, according to the various vibrations of the tympanum (unto which the hammer is faſtened; and therefore is governed by its motions) muſt needs make great difference of bigneſſes, and cauſe great variety of ſmartneſſes of motion, in the little bodies which they forge.

6. How colours are conveyed to the brain by vitall ſpirits.

The laſt ſenſe is of ſeeing; whoſe action we cannot doubt, is performed by the reflection of light unto our eye, from the bodies which we ſee: and this light commeth impregnated, with a tincture drawn from the ſuperficies of the object it is reflected from; that is, it bringeth a long with it, ſeverall of the little atomes, which of themſelves do ſtream, and it cutteth from the body it ſtruck upon, and reboundeth from; and they mingling themſelves with the light, do in company of it get into the eye: whoſe fabrick, is fit to gather and unite thoſe ſpecies, as you may ſee by the anatomy of it: and from the eye, their journey is but a ſhort one to the brain: in which, we cannot ſuſpect that they ſhould loſe their force; conſidering, how others that come from organes further off, do conſerve theirs: and likewiſe conſidering

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the nature of the optick ſpirits, which are conceived to be the moſt refined of all that are in mans body.

Now, that light is mingled with ſuch little atomes iſſuing out of the bodies from which it is reflected; appeareth evidently enough, out of what we have Said, of the natures and operations of fire and light: and it ſeemeth to be confirmed, by what I have often obſerved in ſome chambers where people ſeldome come: which having their windows to the ſouth, ſo as the ſun lyeth upon them a great part of the day in his greateſt ſtrength, and their curtaines being continually drawne over them, the glaſſe becomes dyed very deep of the ſame colour the curtain is of: which can proceed from no other cauſe, but that the beams which ſhoot through the glaſſe, being reflected back from the curtain, do take ſomething along with them from the ſuperficies of it; which being of a more ſolid corpulence then they, is left behind (as it were in the ſtrainer) when they come to preſſe themſelves through paſſages and pores, too little for it to accompany them in: and ſo thoſe atomes of colour, do ſticke upon the glaſſe, which they cannot penetrate.

Another confirmation of it is, that in certain poſitions, the Sun reflecting from ſtrong colours, will caſt that very colour upon ſome other place; as I have often experienced in lively ſcarlet, and cloth of other ſmart colours: and this, not in that gloating wiſe, as it maketh colours of pure light, but like a true reall dye; and ſo, as the colour will appear the ſame to a man whereſoever he ſtandeth.

Having thus ſhewed in all our ſenſes, the conveniency and agreeableneſſe of our opinion with nature; (which hath been deduced, out of the nature of the objects, the nature of our ſpirits, the nature and ſituation of our nerves, and laſtly from the property of our brain:) our next conſideration ſhall be, of the difficulty that occurreth in Mr. des Cartes his opinion. Firſt we know not how to reconcile the repugnancys, appearing in his poſition of the motion of the æther; eſpecially in light, for that Ethereal ſubſtance, being extream rare, muſt perforce be either extream liquid or extream brittle; if the firſt, it cannot choſe but bow and be preſſed into foulds, and bodies of unequal motions, ſwimming every where in it; and ſo it is impoſſible that it ſhould bring unto the eye any conſtant apparition of the firſt mover.

7 Reaſons againſt Mounſieur des Cartes his opinion.

But

But let us ſuppoſe there were no ſuch generall interruptions, every where encountring, and diſturbing the conveyance of the firſt ſimple motion: yet, how can we conceive that a puſh given ſo farre off, in ſo liquid an element, can continue its force ſo farre? We ſee that the greateſt thunders and concuſſions, which at any time happen among us, cannot drive and impart their impulſe the ten thouſandth part of the vaſt diſtance, which the Sun is remo ed from our eye; and can we imagin, that a little touch of that luminous body, ſhould make an impreſſion upon us, by moving another ſo extreamly liquid and ſubtile, as the Ether is ſuppoſed; which like an immenſe Ocean, toſſed with all varieties of motion, lyeth between it and us?

But admit there were no difficulty, nor repugnance in the medium, to convey unto us a ſtroke, made upon it by the Suns motion: let us at the leaſt examin, what kind of motions we muſt allow in the Sun, to cauſe this effect. Certainly, it muſt needs be a motion towards us, or elſe it cannot ſtrike and drive the medium forward, to make it ſtrike upon us. And if it be ſo, either the Sun muſt perpetually be comming nearer and nearer to us; or elſe it muſt ever and anon be receding backwards, as well as moving forwards. Both which, are too chymericall for ſo great a wit to conceit.

Now, if the Ether be brittle, it muſt needs reflect upon every rub it meeteth with in its way, and muſt be broken and ſhivered by every body that moveth a croſſe it: and therefore muſt alwaies make an uncertain and moſt diſorderly percuſſion upon the eye.

Then again; after it is arrived to the ſenſe, it is no waies likely it ſhould be conveyed from thence to the brain, or that nature intended ſuch a kind of inſtrument as a nerve, to continue a preciſe determinate motion: for if you conſider how a lute ſtring, or any other ſuch medium conveyeth a motion made in it; you will finde, that to do it well and clearly, it muſt be ſtretched throughout to its full extent, with a kind of ſtiffneſſe: whereas our nerves are not ſtraight, but lie crooked in our body; and are very lither, til upon occaſion ſpirits comming in o them, do ſwell them out. beſides, they are bound to fleſh, and to other parts of the body; which being ceſſible, muſt needs dul the ſtroak, and not permit it to be carried farre. And

laſtly,

Lastly, the nerves are subject to be at every turn contracted and dilated, upon their own account, without any relation to the stroakes beating upon them from an extern agent: which is by no meanes, a convenient disposition for a body, that is to be the porter of any simple motion; which should alwayes lie watching in great quietnesse, to observe scrupulously, and exactly the errand he is to carry: so that for my part, I cannot conceive, nature Intended any such effect, by mediation of the sinews.

8 That the symptomes of the palsie do no way confirm Monsieur des Cartes his opinion.

But Monsieur des Cartes endeavoureth to confirm his opinion, by what useth to fall out in palsies, when a man loseth the strength of moving his hands, or other members and nevertheless retaineth his feeling: which he imputeth to the remaining intire of the strings of the nerves, whiles the spirits are some way defective. To this we may answer, by producing examples of the contrary in some men, who have had the motion of their limbs intire and no wayes prejudiced, but have had no feeling at all, quite over their whole case of skin and flesh: as particularly a servant in the Colledge of Physicians in London, whom the learned Harvey (one of his Masters) hath told me, was exceeding strong to labour, and very able to carry any necessary burthen, and to remove things dexterously, according to the occasion: and yet he was so void of feeling, that he used to grind his hands against the walls, and against course lumber, when he was imployed to rummage any; in so much, that they would runne with blood, through the grating of the skin, without his feeling of what occasioned it.

In our way, the reason of both these conditions of people, (the paralytick and the insensible) is easy to be rendred: for they proceed out of the divers disposition of the animal spirits in these parts; which if they thicken too much, and become very grosse, they are not capable of transmitting the subtile messengers of the outward world, unto the tribunall of the brain, to judge of them. On the other side, if they be too subtile, they neither have, nor give power to swell the skin, and so to draw the muskles to their heads. And surely Monsieur des Cartes taketh the wrong way, in the reason he giveth of the Palsie: for it proceedeth out of abundance of humours; which clogging the nerves, rendreth them washy, and maketh them lose their drynesse, and become lither, and consequently, unfit and unable, in his

his opinion, for ſenſation (which requireth ſtiffeneſſe) as well as for motion.

9. That Monſieur des *Cartes* his opinion, cannot give a good account, how things are conſerved in the memory.

Yet beſides all theſe, one difficulty more remaineth againſt this doctrin, more inſuperable (if I miſtake not) than any thing or all together, we have yet ſaid: which is, how the memory ſhould conſerve any thing in it, and repreſent bodies to us, when our fanſie calleth for them, if nothing but motions do come into the brain. For it is impoſſible, that in ſo diviſible a ſubject as the ſpirits, motion ſhould be conſerved any long time: as we ſee evidently in the ayr; through which move a flaming taper never ſo ſwiftly, and as ſoon as you ſet it down, almoſt in the very inſtant, the flame of it leaveth being driven or ſhaken on one ſide, and goeth quietly and evenly up its ordinary courſe: thereby ſhewing, that the motion of the ayr which for the time was violent, is all of a ſuddain quieted and at reſt: for otherwiſe, the flame of the taper would blaze that way the Ayr were moved. Aſſuredly, the bodyes that have power to conſerve motion long, muſt be dry and hard ones. Nor yet can ſuch conſerve it very long, after the cauſe which made it, ceaſeth from its operation. How then can we imagine, that ſuch a multitude of pure motions, as the memory muſt be ſtored withall for the uſe and ſervice of a man, can be kept on foot in his brain, without confuſion; and for ſo long a time as his memory is able to extend unto? Conſider a leſſon plaid upon the Lute or Virginals; and think with your ſelfe, what power there is, or can be in nature, to conſerve this leſſon ever continually playing: and reflect, that if the impreſſions upon the common ſenſe are nothing elſe but ſuch things, then they muſt be actually conſerved, alwaies actually moving in our head, to the end they be immediatly produced, whenſoever it pleaſeth our will to call them.

And if peradventure it ſhould be replyed, that it is not neceſſary the motions themſelves ſhould alwaies be conſerved in actuall being; but that it is ſufficient there be certain cauſes kept on foot in our heads, which are apt to reduce theſe motions into act, whenſoever there is occaſion of them: all I ſhall ſay hereunto is, that this is meerly a voluntary poſition, and that there appeareth no ground for theſe motions to make and conſtitute ſuch cauſes; ſince we neither meet with any inſtruments,

ments, nor diſcover any ſignes, whereby we may be induced to believe or underſtand any ſuch operation.

It may be urged, that divers ſounds are by diſeaſes oftentimes made in our eares, and appearances of colours in our fantaſie. But firſt, theſe colours and ſounds, are not artificiall ones, and diſpoſed and ordered by choice and judgement; for no ſtory hath mentioned, that by a diſeaſe any man ever heard twenty verſes of Virgill, or an ode of Horace in his eares: or that ever any man ſaw fair pictures in his fanſy, by means of a blow given him upon his eye. And ſecondly, ſuch colours and ſounds as are objected, are nothing elſe, but (in the firſt caſe) the motion of humours in a mans eye by a blow upon it; which humours have the vertue of making light, in ſuch ſort as we ſee Sea-water hath when it is claſhed together: and (in the ſecond caſe) a cold vapour in certain parts of the brain, which cauſeth beatings or motion there; whence proceedeth the imitation of ſounds: ſo that theſe examples do nothing advantage that party thence to infer, that the ſimilitudes of objects may be made in the common ſenſe, without any real bodies reſerved for that end.

Yet I intend not to exclude motion from any commerce with the memory, no more than I have done from ſenſation. For I will not only grant, that all our remembring is performed by the meanes of motion; but I will alſo acknowledge, that (in men) it is, for the moſt part, of nothing elſe but of motion. For what are words but motion? And words are the chiefeſt objects of our remembrance. It is true, we can, if we will, remember things in their own ſhapes, as well as by the words that expreſſe them; but experience telleth us, that in our familiar converſation, and in the ordinary exerciſe of our memory, we remember and make uſe of the words, rather than of the things themſelves.

Beſides, the impreſſions which are made upon all our other ſenſes, as well as upon our hearing, are likewiſe for the moſt part of things in motion: as if we have occaſion to make a conception of a man, or of a horſe, we ordinarily conceive him Walking, or Speaking, or Eating, or uſing ſome motion in time: and as theſe impreſſions are ſucceſſively made upon the outward Organs; ſo are they ſucceſſively carried into the fantaſie, and

by

by like ſucceſſion, are delivered over into the memory: from whence, when they are called back again into the fantaſie, they move likewiſe ſucceſſively; ſo that in truth, all our memory will be of motion; or in the leaſt, of bodies in motion: yet it is not chiefly of motion, but of the things that are moved; unleſſe it be, when we remember words: and how thoſe motions, do frame bodies which move in the brain, we have already touched.

THE THREE AND THIRTIETH CHAP.

Of Memory.

1 How things are conſerved in the memory.

BUt how are theſe things conſerved in the brain? And how do they revive in the fantaſie, the ſame motions by which they came in thither at the firſt? Monſieur des Cartes hath put us in hope of an explication: and were I ſo happy, as to have ſeen that work of his, which the World of learned men ſo much longeth for; I aſſure my ſelf, I ſhould herein receive great help and furtherance by it. Although withall I muſt profeſſe, I cannot underſtand how it is poſſible, that any determinate motion ſhould long be preſerved untainted in the brain; where there muſt be ſuch a multitude of other motions in the way, to mingle with it, and bring all into confuſion. One day I hope this jewel wil be expoſed to publike view, both to do the Author right, and to inſtruct the World.

In the mean time, let us ſee what our own principles afford us. We have reſolved, that ſenſation is not a pure driving of the animall ſpirits, or of ſome penetrable body in which they ſwim, againſt that part of the brain, where knowledge reſideth: but that it is indeed the driving thither of ſolid materiall bodies (exceeding little ones) that come from the objects themſelves. Which poſition, if it be true, it followeth, that theſe bodies muſt rebound from thence upon other parts of the brain; where at the length they finde ſome vacant cell, in which they keep their ranks and files in great quiet and order; all ſuch ſticking together, and keeping company with one an other, that entered in together: and there they lye ſtill and

and are at reſt, untill they be ſtirred up, either by the naturall appetite, (which is the ordinary courſe of beaſts) or by chance, or by the will of the man in whom they are, upon the occaſions he meeteth with of ſearching into them. Any of theſe three cauſes raiſeth them up, and giveth them the motion that is proper to them; which is the ſame with that, whereby they came in at the firſt: for (as *Galilæus* teacheth us) every body hath a particular motion peculiarly proper to it, when nothing diverteth it; and then they ſlide ſucceſſively, through the fantaſie in the ſame manner, as when they preſented themſelves to it the firſt time. After which, if it require them no more; they return gently to their quiet habitation in ſome other part of the brain, from whence they were called and ſummoned by the fantaſies meſſengers, the ſpirits: but if it have longer uſe of them, and would view them better, than once paſſing through permitteth; then they are turned back again, and lead anew over their courſe, as often as is requiſite: like a Horſe, that a Rider paceth ſundry times along by him, that he ſheweth him to; whiles he is attentive to mark every part and motion in him.

2. How things conſerved in the memory are brought back into the fantaſies.

But let us examin a little more particularly, how the cauſes we have aſſigned, do raiſe theſe bodies that reſt in the memory, and do bring them to the fantaſie. The middlemoſt of them (namely chance) needeth no looking into, becauſe the principles that govern it, are uncertain ones. But the firſt, and the laſt, (which are, the appetite, and the will) have a power (which we will explicate hereafter) of moving the brain and the nerves depending of it, conveniently and agreeably to their diſpoſition. Out of which it followeth, that the little ſimilitudes which are in the caves of the brain wheeling and ſwimming about (almoſt in ſuch ſort, as you ſee in the waſhing of Currants or of Rice, by the winding about and circular turning of the Cooks hand) divers ſorts of bodies do go their courſes for a pretty while; ſo that the moſt ordinary objects cannot chooſe but preſent themſelves quickly, becauſe there are many of them, and are every where ſcattered about: but others that are fewer, are longer ere they come in view: much like as in a pair of beads, that containing more little ones than great ones, if you pluck to you the ſtring, they all hang upon

upon, you shall meet with many more of one sort, than of the other.

Now, as soon as the brain hath lighted on any of those it seeketh for, it putteth as it were a stop upon the motion of that; or at the least, it moveth it so, that it goeth not far away, and is revocable at will: and seemeth like a bait to draw into the fantasie, others belonging unto the same thing, either through similitude of nature, or by their connexion in the impression: and by this means hindereth other objects, not pertinent to the work the fansie hath in hand, from offering themselves unseasonably in the multitudes that otherwise they would do. But if the fansie should have mistaken one object for an other, by reason of some resemblance they have between themselves; then it shaketh again the liquid medium they all float in, and rooseth every species lurking in remotest corners, and runneth over the whole bead-roule of them: and continueth this inquisition and motion, till either it be satisfyed with retriving at length what it required, or that it be grown weary with tossing about the multitude of little inhabitants in its numerous empire, and so giveth over the search, unwillingly and displeasedly.

3. A confirmation of the former doctrine.

Now, that these things be as we have declared, will appear out of the following considerations. First, we see that things of quite different natures, if they come in together, are remembred together: upon which principle the whole art of memory dependeth: such things cannot any way be comprised under certain heads, nor be linked together by order and consequence, or by any resemblance to one another: and therefore all their connexion must be, that as they came in together into the fantasie, so they remain together in the same place in the memory: and their first coupling must proceed from the action that bound them together, in driving them in together.

Next, we may observe, that when a man seeketh and tumbleth in his memory for any thing he would retrive, he hath first some common and confused notion of it: and sometimes he hath a kind of flasking or fading likenesse of it: much what as when in striving to remember a name, men use to say, it is at their tongues end: and this sheweth, that he retracketh those things he desireth, and hath use of, by the likenesse of some-

thing

thing belonging to them. In like manner, when hunger maketh one think of meat, or thirſt maketh one dream of drink, or in other ſuch occaſions, wherein the naturall appetite ſtirreth objects in the memory and bringeth them to the fantaſie; it is manifeſt, that the ſpirits informing the brain of the defect and pain, which ſeverall parts of the body do endure, for want of their due nouriſhment; it giveth a motion to the heart, which ſendeth other ſpirits up to ſupply the brain, for what ſervice it will order them: by which, the brain being fortified, it followeth the purſuite of what the living creature is in want of; untill the diſtempered parts be reduced into their due ſtate, by a more ſolid enjoying of it.

4 How things renewed in the fantaſie, returne with the ſame circumſtances that they had at firſt.

Now, why objects that are drawn out of the memory, do uſe to appeare in the fantaſie, with all the ſame circumſtances which accompanied them at the time when the ſenſe did ſend them thither (as when in the remembrance of a friend we conſider him in ſome place, and at a certain time, and doing ſome determinate action) the reaſon is, that the ſame body, being in the ſame medium, muſt neceſſarily have the ſame kind of motion; and ſo conſequently, muſt make the ſame impreſſion upon the ſame ſubject. The medium which theſe bodies move in, (that is the memory) is a liquid vaporous ſubſtance, in which they float and ſwim at liberty.

Now, in ſuch a kind of medium, all the bodies that are of one nature, will eaſily gather together, if nothing diſturb them: for as when a tuned Lute ſtring is ſtrucken, that ſtring by communicating a determinate ſpecies of vibration to the Ayre round about it, ſhaketh other ſtrings, within the compaſſe of the moved ayre: not all, of what extent ſoever, but onely ſuch, as by their naturall motion, would cauſe like curlings, and foulds in the Ayre, as the other doth; according to what Galileus hath at large declared: even ſo, when ſome atome in the brain is moved, all the reſt there about, which are apt to be waſted with alike undulation, muſt needs be moved in chief: and ſo they moving, whiles the others of different motions that having nothing to rayſe them, do either ly quiet, or move very little in reſpect of the former; it is no wonder if they aſſemble together, (and by the proper courſe of the brain) do meet at the common rendezvous of the fantaſie.

5. How the memory of things past is lost, or confounded: and how it is repaired againe.

And therefore the more impressions, that are made from the same object upon the sense, the more participations of it will be gathered together in the memory: and the stronger impressions, it will upon occasion make in the fantasie: and themselves will be the stronger to resist any cause that shall strive to deface them. For we see, that multitude of objects overwhelmeth the memory; and putteth out, or at the least, maketh unprofitable, those that are seldomest thought on. The reason of which is, that they being little in quantity, because there are but few species of them; they can never strike the seat of knowledge, but in company of others; which being more and greater, do make the impression follow their nature against the lesser: and in tract of time, things seldome thought of, do grow to have but a maimed and confused shape in the memory; and at length are quite forgotten. Which happeneth, because in the liquid medium, they are apt to moulder away, if they be not often repaired: which mouldering and defacing, is helped on by the shockes they receive from other bodies: like as in a magazin, a thing that were not regarded, but were careleſly tumbled up and downe, to make roome for others, and all things were promiscuously throwne upon it; it would soone be bruised and crushed into a mishapen forme, and in the end be broken all in pieces.

Now, the repairing of any thing in the memory, is done by receiving new impressions from the object; or in its absence, by thinking strongly of it: which is an assembling, & due peecing together of the severall particles of bodies, appertaining to the same matter. But sometimes it happeneth, that when the right one cannot be found intire, nor all the orderly pieces of it, be retrived with their just correspondence to one another; the fansie maketh up a new one in the place of it: which afterwards, upon the presence of the object, appeareth to have been mistaken: and yet the memory, till then, keepeth quietly and unquestionedly for the true object, what either, the thought, or chance, mingling severall parts, had patched up together.

And from hence, we may discern, how, the loosing or confounding of ones memory, may happen either by sicknesses, that distemper the spirits in the brain, & disorder their motions, or by some

ſome blowes on the head, whereby a man is aſtonied, and all things ſeem to turn round with him. Of all which effects, the cauſes are eaſy to be found in theſe ſuppoſitions we have layed.

THE FOURE AND THIRTIETH CHAP.

Of voluntary motion, Naturall faculties, and paſſions.

HItherto we have laboured to convey the object into the brain: but when it is there, let us ſee what further effects it cauſeth: and how that action, which we call *voluntary motion*, doth proceed from the brain. For the diſcovery whereof, we are to note, that the brain is a ſubſtance compoſed of watry parts mingled with earthy ones: which kind of ſubſtances we ſee are uſually full of ſtrings: and ſo in ſtrong hard beer, and in vinegar, and in other liquors of the like nature, we ſee (if they be expoſed to the Sun) little long flakes, which make an appearance of Wormes or Maggats floating about. The reaſon whereof is, that ſome dry parts of ſuch liquors, are of themſelves as it were hairy or fleaſy, that is have little downy parts, ſuch as you ſee upon the legs of Flies, or upon Caterpillars, or in little locks of wooll; by which they eaſily catch and ſtick to the other litle parts of the like nature, that come near unto them: and if the liquor be moved, (as it is in the boyling of beer, or making of vinegar by the heat of the Sun) they become long ſtrings; becauſe the liquor breaketh the ties which are croſſe to its motion: but ſuch as lie along the ſtream, or rather the bubling up, do maintaine themſelves in unity, and peradventure grow ſtronger, by the winding or foulding of the end of one part with an other: and in their tumbling and rouling ſtill in the ſame courſe, the downy haires are cruſhed in, and the body groweth long and round, as happeneth to a lump of dough or wax, or wool, rouled a while in one uniform courſe. And ſo, comming to our purpoſe, we ſee that the brain and all that is made of it, is ſtringy; witneſſe, the membranes, the fleſh, the bones, &c. But of all the reſt, thoſe which be called fibers are more ſtringy: and the nerves ſeem to be but an

1 Of what matter the brain is compoſed.

assembly of them: for although the nerves be but a great multitude of strings lying in a cluster; nevertheless, by the consent of Physitians and Anatomists, they are held to be of the very substance of the brain, dryed to a firmer consistance then it is in the head.

This heap of strings (as we may call it) is encloſed in an outside made of membranes; whoſe frame, we need not here display: only we may note, that it is very apt and fit to stretch; and after stretching, to return again to its own just length. Next, we are to consider, how the brain is of a nature apt to swell and to sink again: even so much, that Fallopius reporteth, it doth swell according to the encreaſe of the moon: which whether it be true or no; there can be no doubt, but that it being of a substance which is full of skinnes and strings, is capable of being stretched, and of swelling upon light occasions; and of falling or sinking again upon as light: as being easily penetrable by vapours and by liquors, whoſe nature it is, to swell and to extend that which they enter into. Out of which it followeth, that it must be the nature of the nerves to do the like: and indeed, so much the more, by how much more dry they are then the brain: for we see that (to a certain measure) dryer things are more capable of extention by the ingreſſion of wet, then moist things are; becauſe theſe are not capable of receiving much more wet into them.

2 What is volun tary motion.

Theſe things being premiſed; let us imagine that the brain being first swelled, it doth afterwards contract it self; and it must of neceſſity follow, that seeing the nerves are all open towards the brain (though their concavities cannot be diſcerned) the spirits and moysture which are in the brain, must needs be preſſed into the nerves: which being already stored with spirits, sufficiently to the proportion of their hard skinnes; this addition wil make them swel and grow hard, as a balloone doth, which being competently full of ayr, hath nevertheleſſe more ayr preſſed into it.

Since therefore; the maſters of Anatomy do teach us, that in every muſcle there is a nerve, which is spread into a number of little branches along that muſcle; it must follow, that if theſe little branches be swollen, the fleſh likewiſe of that muſckle must also needs be swollen. Now the muſcle having both its endes faſtened,

faſtned, the one in a greater bone, the other in a leſſer; and there being leaſt reſiſtance on that part, where the bone is leſſer, and more moveable; the ſwelling of the muſcle cannot chooſe, but draw the little bone towards the great one, and by conſequence, move that little bone: and this is that, which Philoſophers uſually call *Voluntary motion*: for ſince our knowledge remaineth in the braine, whatſoever is done by knowledge, muſt be done by the brain; and moſt of what the brain worketh for the common ſervice of the living creature, proceedeth alſo from knowledge; that is from the motion of the fanſie, which we have expreſſed.

3. What thoſe powers are which are called naturall faculties.

This matter being thus far declared, we may now enter upon the explication of certaine effects; which peradventure might have challenged roome, in the precedent Chapter; but indeed, could not well be handled without firſt ſuppoſing this laſt diſcourſe: and it is, what is meaned by thoſe powers, that are called natural faculties: the which howſoever in their particulars they be manifold in a living creature, yet whenſoever any of them is reſolved, it appeareth to be compounded of ſome of theſe five; to wit the attractive, the retentive, the ſecretive, the concoctive, and the expulſive faculty.

Of which the attractive, the ſecretive, and the concoctive do not ſeeme to belong unto the nerves, for although we may conceive, that the part of the animall doth turne it ſelfe towards the thing which it attracteth; nevertheleſſe, that very turning ſeemeth not to be done by vertue of the muſcles, and of the nerves, but rather in a naturall way, as the motion of the heart is performed, in ſuch ſort as we have formerly declared: as for example, if the ſtomack when it is greedy of meat, draweth it ſelf up towards the throat, it ſeemeth rather to be a kind of dryneſſe and of warping, ſuch as we ſee in bladders or in leather, either by fire or by cold, which make them ſhrivel up and grow hard; then that it is a true faculty of the living creature to ſeek after meat.

4. How the attractive and ſecretive faculties work.

Nor need we extend our diſcourſe any further about theſe three faculties; ſeeing that we have already declared in common, how attraction, drying and mixture of active bodies with paſſive ones, is performed; which needeth but applying unto theſe particulars, to explicate fully their natures: as for example;

if the Kidneyes draw the matter of Urine unto them out of the Veines, it may be by any of the following three manners, to wit, either by draught, wet, or by ſteame. For if the ſerous parts that are in the blood which runneth in the Veines, do touch ſome dry parts conformable to their nature, tending towards the Kidneyes; they will infallibly adhere more to thoſe dry parts, then to the reſt of the blood. Which if they do in ſo great a quantity, that they reach to other further parts more dry then theſe, they will leave the firſt parts to go to the ſecond: and thus by little, and little, will draw a line of Urine from the blood, if the blood do abound with it: and the neerer it commeth to the Kidneyes, the ſtronger ſtill the attraction will be.

The like will happen, if the ſerofity which is in the blood, do touch ſome part wetted with a like ſerofity, or where ſuch hath lately paſſed; for as we ſee that water will run more eaſily upon a wet part of a board or a ſtone, then upon a dry one; ſo you cannot doubt, but that if the ſerous part, which is mixed with the blood, do light upon a current of its own nature, it will ſtick more to that, then to the current of the blood; and ſo part from the blood, to goe that way which the current of its own nature goeth.

Beſides, it cannot be doubted, but that from the Kidneyes, and from the paſſages between the Kidneys, and the Veines, in which the blood is conveyed, there ariſeth a ſteame: whoſe nature is, to incorporate it ſelfe with ſerous matter, out of whoſe body it hath been extracted. This ſteame therefore, flying ſtill to the ſerous blood which paſſeth by, muſt of neceſſity precipitate (as I may ſay) the ſerous parts of that blood; or rather muſt filter them out of their maine ſtock; and ſo will make them run in that current, from which it ſelfe doth flow. And thus you ſee how *Attraction* and *Secretion* are made: for the drawing of the ſerofity, without drawing the blood, is the parting of the Urine from the blood. And this example, of the Kidneyes operation, may be applyed to the attractions of all the other parts.

5. Concerning the concoctive faculty.

Now the concoctive faculty (which is the laſt or the three we took together) conſiſteth of two parts: the one is, as it were a drying of the humour, which is to be concocted, the other is, a ming-

a mingling the ſubſtance of the veſſell in which the humour is concocted, with the humor it ſelf: for as if you boyle divers kinds of liquors in braſſe pannes, the pannes will taynt the liquor with the quality of the braſſe; and therefore Phyſitians forbid the uſe of ſuch, in the boyling of ſeverall medicines: ſo much more in a living creatures body, there can be no doubt, but that the veſſel in which any humour is concocted, doth give a tincture thereunto. Now concoction conſiſting in theſe two, it is evident, what the concoctive vertue is; to wit, heat, and the ſpecificall property of the veſſel which by heat is mingled with the humour.

6 Concerning the retentive and expulſive faculties.

There remaine yet, the retentive and the expulſive faculties to be diſcourſed of; whereof one kind, is manifeſtly belonging to the voluntary motion which we have declared: namely that retention, and that expulſion, which we ordinarily make of the groſſe excrements either of meat, or of drink, or of other humours, either from our head, or from our ſtomack, or from our Lungs; for it is manifeſtly done, partly by taking in of wind, and partly by comperſſing of ſome parts and opening of others: as Galen ſheweth in his curious book *de uſu partium.*

Another kind of retention and expulſion: in which we have no ſenſe when it is made, (or if we have, it is of a thing done in us without our will, though peradventure we may voluntarily advance it) is made by the ſwelling of fibers in certain parts, through the confluence of humours to them, (as in our ſtomack it happeneth, by the drink and the juice of the meat that is in it) which ſwelling, cloſeth up the paſſages by which the contained ſubſtance ſhould go out (as the moyſtening of the ſtrings, and mouth of a purſe, almoſt ſhutteth it) untill in ſome (for example, the ſtomack, after a meale) the humour being attenuated by little and little, getteth out ſubtilely; and ſo leaving leſſe weight in the ſtomack, the bag which weigheth down lower, then the neather Orifice at which the digeſted meat iſſueth, riſeth a little: and this riſing of it is alſo furthered by the wrinkling up and ſhortning of the upper part of the ſtomach; which ſtill returneth into its naturall corrugation, as the maſſe of liquid meat leaveth ſoaking it) which it doth by degrees, ſtill as more and more goeth out; and ſo what remaineth filleth leſſe place,

and reacheth not ſo high of the ſtomack: and thus at length, the reſidue and thicker ſubſtance of the meat, after the thinneſt is got out in ſteame, and the middling part is boyled over in liquor, commeth to preſſe and gravitate wholly upon the oriſice of the ſtomack; which being then helped by the figure and lying of the reſt of the ſtomack, and its ſtrings and mouth relaxing, by having the juice which ſwelled them, ſqueezed out of them; it openeth it ſelf, and giveth way unto that which lay ſo heavy upon it, to tumble out. In others (for example, in a woman with child) the encloſed ſubſtance, (retained firſt by ſuch a courſe of nature as we have ſet down) breaketh it ſelf a paſſage by force, and openeth the orifice at which it is to go out by violence, when all circumſtances are ripe, according to natures inſtitution.

7 Concerning expulſion made by Phyſick.

But yet there is the expulſion which is made by phyſick, that requireth a little declaration. It is of five kinds: vomitting, purging by ſtoole, by urine, ſweating, and ſalivation. Every one of which, ſeemeth to conſiſt of two parts, namely, the diſpoſition of the thing to be purged, and the motion of the nerves or fibers for the expulſion: as for example, when the Phyſitian giveth a purge, it worketh two things: the one is, to make ſome certain humour more liquid and purgeable then the reſt; the other is, to make the ſtomack or belly, ſuck or vent this humour. For the firſt, the property of the purge muſt be to precipitate that humour out of the reſt of the blood; or if it be thick, to diſſolve it that it may runne eaſily. For the ſecond, it ordinarily heateth the ſtomack; and by that meanes it cauſeth the ſtomack to ſuck out of the veines, and ſo to draw from all parts of the body. Beſides this, it ordinarily filleth the belly with wind, which occaſioneth thoſe gripings men feel when they take phyſick; and is cauſe of the guts diſcharging thoſe humours, which otherwiſe they would retaine.

The like of this happened in ſalivation; for the humours are by the ſame means brought to the ſtomack, and thence ſublimed up to be ſpitten out: as we ſee in thoſe, who taking Mercury into their body, either in ſubſtance or in ſmoke, or by application, do vent cold humours from any part; the Mercury riſing from all the body up to the mouth of the patient, as to the helm

of a ſublimatory: and the like ſome ſay of Tobacco.

As for vomiting, it is in a manner wholly the operation of the fibers, provoked by the feeling of ſome inconvenient body, which maketh the ſtomack wrinkle it ſelf, and work and ſtrive to caſt out what offendeth it.

Sweating ſeemeth to becauſed, by the heating of ſome introus body by the ſtomack; which being of ſubtile parts, is by heat diſperſed from the middle to the circumference; and carrieth with it light humours, which turn into water as they come out into the ayr. And thus you ſee in generall, and as much as concerneth us to declare, what the natural faculties are: and this according to Galen his own mind: who affirmeth, that theſe faculties do follow the complexion, or the temper of the parts of a mans body.

8 How the brain is moved to work voluntary motion.

Having explicated how voluntary motion proceedeth from the brain: our next conſideration ought to be, to examine what it is, that ſuch an object, as we brought, by meanes of the ſenſes, into the brain from without, doth contribute to make the brain apply it ſelf to work ſuch voluntary motion. To which purpoſe, we will go a ſtep or two back, to meet the object at its entrance into the ſenſe; and from thence accompany it in all its journey and motions onwards. The object which ſtriketh at the ſenſes dore, and getting in, mingleth it ſelf with the ſpirits it findeth there; is either conform and agreeable to the nature and temper of thoſe ſpirits, or it is not: that is to ſay, in ſhort, it is either pleaſing or diſpleaſing to the living creature: or it may be of a third kind, which being neither of theſe, we may terme indifferent. In which ſort ſoever the object affect the ſenſe, the ſpirits carry it immediately to the brain, unleſſe ſome diſtemper or ſtrong thought, or other accident hinder them.

Now, if the object be of the third kind; that is, be indifferent; as ſoon as it hath ſtrucken the braine, it reboundeth to the circle of the memory: and there, being ſpeedily joyned to others of its own nature, it findeth them annexed to ſome pleaſing or diſpleaſing thing, or it doth not: if not, in beaſts it ſerveth to little uſe: and in men, it remaineth there untill it be called for: but if, either in its own nature, it be pleaſing or diſpleaſing; or afterwards in the memory it became

Became joyned to ſome pleaſing or annoying fellowſhip; preſently, the heart is ſenſible of it: for the heart being joyned to the brain by ſtraight and large nerves, full of ſtrong ſpirits which aſcend from the heart; it is impoſſible, but that it muſt have ſome communication with thoſe motions, which paſſe in the brain: upon which the heart, or rather the ſpirits about it, is either dilated or compreſſed.

And theſe motions, may be either totally of one kind, or moderated, and allayed by the mixture of its contrary: if of the former ſort; one of them we call *joy*, the other *griefe*; which do continue about the heart (and peradventure do oppreſſe it, if they bee in the utmoſt extremity) without ſending any due proportion of ſpirits to the brain, untill they ſettle a little, and grow more moderate.

Now, when theſe motions are moderate, they immediately ſend up ſome aboundance of ſpirits to the brain, which if they be in a convenient proportion, they are by the brain thruſt into ſuch nerves as are fit to receive them: and ſwelling them, they give motion to the muſcles and tendons that are faſtned to them: and they do move the whole body, or what part of it is under command of thoſe nerves, that are thus filled and ſwelled with ſpirits by the brain.

If the object was conformable to the living creature, then the brain ſendeth ſpirits into ſuch nerves, as carry the body to it: but if otherwiſe, it cauſeth a motion of averſion or flight from it. To the cauſe of this latter, we give the name of *Feare*: and the other, that carrieth on to the purſuit of the object, we call *Hope*. *Anger*, or *Audacity*, is mixed of both theſe; for it ſeeketh to avoid an evil by embracing and overcomming it: and proceedeth out of abundance of ſpirits.

Now, if the proportion of ſpirits ſent from the heart, be too great for the brain, it hindereth or perverteth the due operation both in man and beaſt.

Why pleaſing objects do dilate the ſpirits & diſpleaſing ones contract them.

All which it will not be amiſſe to open a little more particularly: and firſt, why painfull or diſpleaſing objects, do contract the ſpirits, and gratefull ones, do contrary wiſe dilate them? It is, becauſe the good of the heart conſiſteth in life, that is in heat & moyſture: and it is the nature of heat, to dilate it ſelf

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in moyſture; whereas cold and dry things, doe contract the bodies they work upon: and ſuch are enemies to the nature of men and beaſts: and accordingly experience, as well as reaſon, teacheth us, that all objects, which be naturally good, are ſuch as be hot and moyſt in the due proportion to the creature that is affected and pleaſed with them.

Now, the living creature being compoſed of the ſame principles, as the world round about him is; and the heart being an abridgement of the whole ſenſible creature; and being moreover full of blood, and that very hot; it commeth to paſſe, that if any of theſe little extracts of the outward world, doe arrive to the hot blood about the heart, it worketh in this blood ſuch like an effect, as we ſee a drop of water falling into a glaſſe of wine, which is preſently diſperſed into a competent compaſſe of the wine: ſo that any little object muſt needs make a notable motion in the blood about the heart.

This motion, according to the nature of the object, will be either conformable or contrary; unleſſe it be ſo little a one, as no effect will follow of it; and then, it is of that kinde, which above we called indifferent. If the enſuing effect be connaturall to the heart, there riſeth a motion of a certaine fume about the heart; which motion we call *pleaſure*; and it never fayleth of accompanying all thoſe motions which are good, as *Joy*, *Love*, *Hope*, and the like: but if the motion be diſpleaſing; there is likewiſe a common ſenſe of a heavineſs about the heart, which we call *griefe*: and it is common to *ſorrow*, *feare*, *hate*, and the like.

Now it is manifeſt by experience, that theſe motions are all of them different ones, and doe ſtrike againſt divers of thoſe parts of our body which encompaſſe the heart: out of which ſtriking followeth, that the ſpirits ſent from the heart, doe affect the braine diverſly; and are by it, conveyed into divers nerves: and ſo doe ſet divers members in action. Whence followeth, that certaine members are generally moved upon the motion of ſuch a paſſion in the heart, eſpecially in beaſtes, who have a more determinate courſe of working, then man hath: and if ſometimes we ſee variety, even in beaſtes, upon knowledge of the circumſtances, we may eaſily gueſſe at the cauſes of that variety: the particularities

became joyned to some pleasing or annoying fellowship; presently, the heart is sensible of it: for the heart being joyned to the brain by straight and large nerves, full of strong spirits which ascend from the heart; it is impossible, but that it must have some communication with those motions, which passe in the brain: upon which the heart, or rather the spirits about it, is either dilated or compressed.

And these motions, may be either totally of one kind, or moderated, and allayed by the mixture of its contrary: if of the former sort; one of them we call *joy*, the other *griefe*; which do continue about the heart (and peradventure do oppresse it, if they bee in the utmost extremity) without sending any due proportion of spirits to the brain, untill they settle a little, and grow more moderate.

Now, when these motions are moderate, they immediately send up some aboundance of spirits to the brain, which if they be in a convenient proportion, they are by the brain thrust into such nerves as are fit to receive them: and swelling them, they give motion to the muscles and tendons that are fastned to them: and they do move the whole body, or what part of it is under command of those nerves, that are thus filled and swelled with spirits by the brain.

If the object was conformable to the living creature, then the brain sendeth spirits into such nerves, as carry the body to it: but if otherwise, it causeth a motion of aversion or flight from it. To the cause of this latter, we give the name of *Feare*: and the other, that carrieth on to the pursuit of the object, we call *Hope*. *Anger*, or *Audacity*, is mixed of both these; for it seeketh to avoid an evil by embracing and overcomming it: and proceedeth out of abundance of spirits.

Now, if the proportion of spirits sent from the heart, be too great for the brain, it hindereth or perverteth the due operation both in man and beast.

Why pleasing objects do dilate the spirits & displeasing ones contract them.

All which it will not be amisse to open a little more particularly: and first, why painfull or displeasing objects, do contract the spirits, and gratefull ones, do contrary wise dilate them? It is, because the good of the heart consisteth in life, that is in heat & moysture: and it is the nature of heat, to dilate it self

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in moysture; whereas cold and dry things, doe contract the bodies they work upon: and such are enemies to the nature of men and beasts: and accordingly experience, as well as reason, teacheth us, that all objects, which be naturally good, are such as be hot and moyst in the due proportion to the creature that is affected and pleased with them.

Now, the living creature being composed of the same principles, as the world round about him is; and the heart being an abridgement of the whole sensible creature; and being moreover full of blood, and that very hot; it commeth to passe, that if any of these little extracts of the outward world, doe arrive to the hot blood about the heart, it worketh in this blood such like an effect, as we see a drop of water falling into a glasse of wine, which is presently dispersed into a competent compasse of the wine: so that any little object must needs make a notable motion in the blood about the heart.

This motion, according to the nature of the object, will be either conformable or contrary; unlesse it be so little a one, as no effect will follow of it; and then, it is of that kinde, which above we called indifferent. If the ensuing effect be connaturall to the heart, there riseth a motion of a certaine fume about the heart; which motion we call *pleasure*; and it never fayleth of accompanying all those motions which are good, as *Joy*, *Love*, *Hope*, and the like: but if the motion be displeasing; there is likewise a common sense of a heavinesse about the heart, which we call *griefe*: and it is common to *sorrow*, *feare*, *hate*, and the like.

Now it is manifest by experience, that these motions are all of them different ones, and doe strike against divers of those parts of our body which encompasse the heart: out of which striking followeth, that the spirits sent from the heart, doe affect the braine diversly; and are by it, conveyed into divers nerves: and so doe set divers members in action. Whence followeth, that certaine members are generally moved upon the motion of such a passion in the heart, especially in beastes, who have a more determinate course of working, then man hath: and if sometimes we see variety, even in beastes, upon knowledge of the circumstances, we may easily guesse at the causes of that variety: the particularities

rities of all which motions, we remit to Phyſitians and to Anatomiſts: advertiſing onely, that the fume of pleaſure, and the heavineſſe of griefe, doe plainly ſhew, that the firſt motions doe participate of dilatation, and the latter of compreſſion.

10. Concerning the five ſenſes of what uſe & end they are.

Thus you ſee, how by the ſenſes, a living creature becommeth judge of what is good, and of what is bad for him: which operation, is performed more perfectly in beaſts; and eſpecially in thoſe, who live in the free ayre, remote from humane converſation (for their ſenſes are freſh and untaynted, as nature made them) then in men. Yet without doubt nature hath been as favourable in this particular to men, as unto them: were it not, that with diſorder and exceſſe, we corrupt and oppreſſe our ſenſes: as appeareth evidently by the ſtory we have recorded of John of Leige: as alſo by the ordinary practice of ſome Hermites in the deſerts, who by their taſt or ſmell, would preſently be informed whether the herbes, and roots, and fruits they met withall, were good or hurtfull for them, though they never before had triall of them.

Of which excellency of the ſenſes, there remaineth in us onely ſome dimme ſparkes, in thoſe qualities which we call ſympathies and antipathies: whereof the reaſons are plaine, out of our late diſcourſe: and are nothing elſe, but a conformity or oppoſition of a living creature, by ſome individual property of it, unto ſome body without it: in ſuch ſort, as its conformity or oppoſition unto things by its ſpecifical qualities, is termed naturall or againſt nature. But of this we ſhall diſcourſe more at large hereafter.

Thus it appeareth, how the ſenſes are ſeated in us, principally for the end of moving us to, or from objects, that are good for us, or hurtfull to us. But though our Reader be content to allow this intent of nature, in our three inferiour ſenſes; yet he may peradventure not be ſatisfied, how the two more noble ones (the hearing and the ſeeing) doe cauſe ſuch motions to, or from objects, as are requiſite to be in living creatures for the preſervation of them; for (may he ſay) how can a man, by onely ſeeing an object, or by hearing the ſound of it, tell what qualities it is imbued withall? Or what motion of liking or diſliking, can be cauſed in his heart, by his meere receiving the viſible

ble ſpecies of an object at his eyes, or by his eares hearing ſome noiſe it maketh? and if there be no ſuch motion there, what ſhould occaſion him, to proſecute or avoyd that object? When he taſteth, or ſmelleth, or toucheth a thing, he findeth it ſweet, or bitter, or ſtinking, or hot, or cold; and is therewith either pleaſed or diſpleaſed: but when he onely ſeeth or heareth it, what liking or diſliking can he have of it, in order to the preſervation of his nature?

The ſolution of this difficulty, may in part appear out of what we have already ſaid. But for the moſt part, the objects of theſe two nobler ſenſes do move us, by being joyned in the memory with ſome other thing that did either pleaſe or diſpleaſe ſome of the other three ſenſes. And from thence it is, that the motion of going to imbrace the object, or averſion from it, doth immediately proceed: as when a dog ſeeth a man that uſed to give him meat, the ſpecies of the man coming into his fanſie, calleth out of his memory the others which are of the ſame nature, and are former participations of that man, as well as this freſh one is: but theſe are joyned with ſpecieſes of meat, becauſe at other times they did uſe to come in together: and therefore the meat being a good unto him, and cauſing him (in the manner we have ſaid) to move towards it; it wil follow that the dog will preſently move towards that man, and expreſſe a contentednes in being with him. And this is the ground of all aſſuefaction in beaſts, and of making them capable of receiving any inſtructions.

THE FIVE AND THIRTIETH CHAPTER.

Of the materiall inſtruments of Knowledge and Paſſion; of the ſeverall effects of Paſſion; of Pain and Pleaſure; and how the vitall ſpirits are ſent from the brain into the intended parts of the body, without miſtaking their way.

TO conclude this great buſineſſe, which concerneth all the mutations and motions, that are made by outward Agents in a living creature, it will not be amiſſe to take a ſhort and generall ſurvey of the materiall inſtruments, which concur

1 That *Septum Lucidum* is the ſeat of the fanſie.

concur to this effect. Whereof the braine being the principall, or at leaſt, the firſt and next of the principals; we may take notice that it containeth, towards the middle of its ſubſtance, four concavities, as ſome do count them: but in truth, theſe four, are but one great concavity, in which four, as it were, divers roomes, may be diſtinguiſhed. The neather part of theſe concavities, is very unequal, having joyned unto it a kind of net, wrought by the entangling of certain little arteries, and of ſmall emanations from a *Sinus*, which are interwoven together. Beſides this, it is full of kernels, which do make it yet more uneven.

Now, two rooms of this great concavity, are divided by a little body, ſomewhat like a skin, (though more fryable) which of it ſelf is clear; but there it is ſomewhat dimmed, by reaſon that hanging a little ſlack, it ſomewhat ſhriveleth together: and this, Anatomiſts do call *Septum lucidum*, or *ſpeculum*; and is an indifferent body from all the reſt that are in the brain. This tranſparent body hangeth as it were ſtraightwards from the forehead towards the hinder part of the head; and divideth the hollow of the brain, as far as it reacheth, in to the right and the left ventricles.

This part ſeemeth to me, (after weighing all circumſtances and conſidering all the conveniences, and fitneſſes) to be that and onely that, in which the fanſie or common ſenſe reſideth: though Monſieur des Cartes hath rather choſen a kernell to place it in. The reaſons of my aſſertions are; firſt, that it is in the midle of the brain, which is the moſt convenient ſituation to receive the meſſages from all our body, that do come by nerve, ſome from before, and ſome from behind. Secondly, that with its two ſides, it ſeemeth to be conveniently oppoſed to all ſuch of our ſenſes, as are double; the one of them ſending its little meſſengers or atomes, to give it advertiſements on one ſide, the other on the other ſide; ſo that it is capable of receiving impreſſion indifferently from both. Again, by the nature of the body, it ſeemeth more fit to receive all differences of motion, then any other body neer it. It is alſo moſt conformable to the nature of the eye; which being our principal outward ſenſe muſt needs be in the next degree to that which is elevated a ſtrain above our outward ſenſes. Fiftly, it is of a ſingle & peculiar nature, whereas the kernels are many, and all of them of the ſame

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condition: quality and appearance. Sixtly it is ſeated in the very hollow of the brain; which of neceſſity muſt be the place and receptacle where the ſpecies and ſimilitudes of things doe reſide, and where they are moved and tumbled up and down, when we think of many things. And laſtly, the ſituation we put our head in, when we think earneſtly of any thing, favoureth this opinion: for then we hang our head forwards, as it were forcing the ſpecieſes to ſet tle towards our forehead, that from thence they may rebound, and work upon this diaphanous ſubſtance.

2. What cauſeth us to remember not only the object it ſelf, but alſo that we have thought of it before.

This then ſuppoſed, let us conſider, that the atomes or likeneſſes of bodies, having given their touch upon this *Septum* or *Speculum*, do thence retire back into the concavities, and doe ſtick (as by chance it happeneth) in ſome of the inequalities they encounter with there. But if ſome winde or forcible ſtream, ſhould break into theſe caves, and as it were bruſh and ſweep them over; it muſt follow, that theſe little bodies will looſen themſelves, and begin to play in the vapour which filleth this hollow place: and ſo floting up and down, come anew to ſtrike and work upon the *Speculum* or fantaſie: which being alſo a ſoluble body, many times theſe atomes ſtriking upon it, do carry ſome little corporeall ſubſtance from it ſticking upon them: whence enſueth, that they returning again with thoſe tinctures or participations of the very ſubſtance of the fantaſie; do make us remember, not only the objects themſelves, but alſo that we have thought of them before.

3. How the motions of the fantaſie, are derived to the heart.

Further we are to know, that all the nerves of the brain, have their beginnings not far from this *Speculum*: of which we ſhall take a more particular conſideration of two, that are called the ſixt pair or couple: which pair hath his ſingularity, that it beginneth in a great many little branches, that preſently grow together, and make two great ones contained within one skin. Now this being the property of a ſenſe (which requireth to have many fibers in it, to the end that it may be eaſily and vigorouſly ſtrucken, by many parts of the object lighting upon many parts of thoſe little fibers) it giveth us to underſtand, that this ſixt couple hath a particular nature, conformable to the nature of an externe ſenſe, and that the Architect who placed it there, intended by the ſeveral conduits of it, to give notice unto ſome part they goe unto, of what paſſeth in the brain: and accordingly

dingly one branch of this nerve, reacheth to the heart; not only to the Pericardium, as Galen thought, but even to the very ſubſtance of the heart it ſelf, as later Anatomiſts have diſcovered: by which we plainly ſee how the motion which the ſenſes do make in the *Speculum*, may be derived down to the heart.

4 Of pain and pleaſure.

Now therefore let us conſider, what effects the motions ſo conveyed from the brain, will work in the heart. Firſt remembring, how all that moveth the heart, is either pain or pleaſure (though we do not uſe to call it pain, but grief, when the evill of ſenſe moveth us only by memory, and not by being actually in the ſenſe) and then calling to mind, how pain (as Naturaliſts teach us) conſiſteth in ſome diviſion of a nerve, (which they call *Solutio continui*: and muſt be in a nerve; for that no ſolution can be the cauſe of pain, without ſenſe, nor ſenſe be without nerves; and therefore this ſolution muſt needs be in nerves, to have it prove painfull,) we may conclude, that the effect which we call pain, is nothing elſe but a compreſſion: for although this ſolution of continuity may ſeem to be a dilatation; yet in truth, it is a compreſſion in the part where the evill is, which happeneth unto it in the ſame manner as we ſhewed (when we ſpoke of the motion of reſtitution) it doth to ſtiffe bodies, that by violence are compreſſed and drawn into a leſſe capacious figure, then their nature affecteth, and return into their own ſtate, as ſoon as the maſtring violence leaveth them at liberty.

Pleaſure therefore, muſt be contrary to this, and conſiſt in a moderate dilatation; for an immoderate one, would cauſe a compreſſion in ſome adherent parts; and there would become pain. And conformable to this, we experience, that generally they are hard things which breed pain unto us; and that theſe which breed pleaſure, are oyly and ſoft; as meates, and odours, which are ſweet to the taſt and ſmel; and ſoft ſubſtances, which are gratefull to the touch: the exceſſe of all which proveth offenſive and painfull; ſo that from the extremity of pleaſure, one entreth preſently upon the confines of pain.

Now then let us conſider, how the little ſimilitudes of bodies which from without do come into the fantaſy, muſt of neceſſity work there; according to their little power, effects pro-

proportionable to what they wrought first in the outward senses, from whence, they were conveyed to the brain: for the sinnes (that is the nerves) and the *Septum lucidum*, having both of them their origin from the very substance of the brain, and differing only in degrees of purity and refinement, the same object must needs work like effects in both, compressing or dilating them proportionably to one another: which compression or dilatation, is not pain or pleasure, as it is in the outward sense; but as it is reported to the heart: and that, being the seat of all paines or pleasures wrought in other parts, and that (as it were) dyeth them into those qualities, is not capable of feeling either it self: so that the strokes of any little similitudes upon the fantasy, do make only compressions or dilatations there, not paines or pleasures.

5 Of passion.

Now their bodies or similitudes, if they be reverberated from the fantasy or *septum Lucidum*, upon the little roots of the nerves of the sixt couple, which go to the heart, they must needs work there a proportionable impression to what they wrought upon the fansy, either compressing or dilating it; and the heart being extreamly passive, by reason of its exceeding tenderness and heat; cannot choose but change its motion, at the least in part, if not in whole: and this with relation to two causes: the one disposition of the heart it self; the other, the vehemency of the stroak.

This change of motion and different beating of the heat, is that which properly is called passion: and is ever accompanied with pleasure or with grief, according to the nature of the impression, that either contracteth or dilateth the heart and the spirits about it: and is discovered by the beating of the arteries and of the pulse. Conformable whereunto, Physitians do tell us, that every passion hath a distinct pulse.

6 Of severall pulses caused by passions.

These pulses are divided in common, by aboundance, or by want of spirits: yet in both kinds, they may have common differences; for in aboundance, the pulse may be quick or slow, regular or irregular, equal or unequal: and the like may happen in defect of spirits; accordingly to the motions of the heart, which are their causes. Again, the object by being present or further off, maketh the stroak greater or lesser: and accordingly varieth the motion of the heart.

Let us then call to mind, how we have formerly declared,

that life consisteth in heat and humidity; and that these two joyned together, do make a thing great: and we may conclude that of necessity the motion which is most lively, must have a great, full, and large stroak; like the even rolling waves of a wide and smooth sea; and not too quick or smart, like the breaches of a narrow *Fretum*, agitated by tempestuous windes. From this, other motions may vary either by excesse, or by deficiency: the first maketh the stroak become smart, violent and thick: the other slackeneth it and maketh it grow little, slow, weak, and thin, or seldome.

And if we look into the motions of our heart, we shall see these three differencies of them follow three several chief passions. The first, followeth the passion of joy: the second, the passion of anger: and the third the passion of grief. Nor need we look any further into the causes of the several motions; for we see that joy and grief, following the stroak of sense, the one of them must consist in an oyly dilatation: that is, the spirits about the heart, must be dilated by a gentle, large, great, and sweet motion, in a moderation between velocity and slownesse: the other contrariwise, following the stroak of sense in pain, as the first did in pleasure, must contract the spirits; and consequently make their motion or stroak become little, and deficient from all the properties we have above set down.

As for anger, the motion following that passion, is, when the aboundance of spirits in the heart is a little checked by the contrary stroak of sense, but presently overcommeth that opposition: and then, as we see a hindred water, or a man, that suddainly or forcibly break through what withstood their motion, go on with a greater violence then they did, and as it were precipitately: so the heart, having overcome the contraction, which the sense made in it, dilateth it self with a fury, and maketh its motion smart and vehement. Whence also it followeth, that the spirits grow hotter then they were: and accordingly, it is often seen, that in the scoulding of a woman, and in the irritation of a dog, if ever now & then, one thwart them, and interpose a little opposition, their fury will be so sharpened and heightned, that the woman will be transported beyond all limits of reason, and the dog will be made mad with nothing else done to him, but angring him at convenient times: and

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ſome men likewiſe, have by ſlight oppoſition, iterated ſpeedily upon them before their ſpirits could relent their vehement motion (and therefore, muſt ſtill encreaſe it) been angred, into feavers.

This paſſion of anger, ſeemeth almoſt to be ſolitary on the ſide of exceſſe beyond joy: which is, as it were the ſtanderd and perfection of all paſſions; as light or whiteneſſe, is of all colours: but on the other ſide, of deficiency, there are ſeveral middle paſſions, which participate more or leſſe of joy and greif: as particularly thoſe two famous ones, which govern mans life, *Hope* and *Fear*. Concerning which Phyſitians tell us, that the pulſe or beating of fear, is quick, hard, and unequal: unto which I conceive we may ſafely adde, that it muſt alſo be ſmall and feeble; the perfection of joy, decreaſing in it on one ſide, to wit, from greatneſſe and largeneſſe; but not intirely; ſo that a kind of quickneſſe ſupplyeth in part the other defect. Hope on the other ſide, is in ſuch ſort defective from joy, that nevertheleſſe it hath a kind of conſtancy, and moderate quantity, and regularity in its motion: and therefore is accounted to be the leaſt hurtfull of all the paſſions, and that which moſt prolongeth mans life. And thus you ſee how thoſe motions, which we call paſſions are engendered in the heart, and what they are.

Of ſeveral other effects cauſed naturally in the body by paſſions.

Let us then in the next place conſider, what will follow in the reſt of the body, out of theſe varieties of paſſion once rayſed in the heart, and ſent into the brain. It is evident, that according to the nature and quality of theſe motions, the heart muſt needs in every one of them, voyd out of it ſelf into the arteries a greater or leſſer quantity of blood, and that in divers faſhions: and the arteries which lie fitteſt to receive theſe ſudden egeſtions of blood are thoſe which go into the brain: whoſe courſe being directly upwards, we cannot doubt, but that it is the hotteſt and ſubtileſt part of the blood, and the fulleſt of ſpirits, that flyeth that way. Theſe ſpirits then running a long and perplexed journey up and down in the brain, by various meanders and anfractuoſities, are there mingled with the humide ſteam of the brain it ſelf, and are therewith cooled; and do come at the laſt, to ſmoak at liberty in the hollow ventricles of the brain, by reeking out of the little arteriall branches, that do weave the *plexus choroides*, or net we ſpoke of erewhile: and

they being now grown heavy, do fall (by their naturall course) into that part or processe of the brain, which is called *medulla spinalis*, or the marrow of the back bone: which being all beset by the nerves that run through the body, it cannot happen otherwise, but that these thickened and descending spirits, must either fall themselves into those nerves, or else presse into them other spirits which are before them, that without such new force to drive them violently forwards, would have slided down more leisurely. Now, this motion being downwards, and meeting with no obsticle till it arrive unto its utmost periode that way, the lowest nerves are these, which naturally do feel the communication of these spirits first.

But it is true, if the flowing tide of them be great and plentifull, all the other nerves wil also be so suddenly filled, upon the filling of the lowermost, that the succession of their swellings, will hardly be perceptible: as a sudden and violent inundation of water, seemeth to rise on the sides of the chanell, as it doth at the mill-damme; though reason assureth us it must begin there, because there it is first stopped.

On the contrary side, if the spirits be few, they may be in such a proportion, as to fill only the lower nerves, and to communicate little of themselves to any of the others. And this is the case in the passion of fear: which being stored with fewer spirits, then any other passion that causeth a motion in the body, it moveth the legs most; and so carrieth the animal that is affrayd, with violence from the object that affrighteth him. Although in truth, it is a faint hope of escaping, mingled with fear, which begetteth this motion: for when fear is single, and at its height, it stoppeth all motion by contracting the spirits, and thence is called *stupor*; as wel as grief, for the same reason: and accordingly we see extream Cowards in the extremity of their fear, have not the courage to run away, no more then to defend or help themselves by any other motions.

But if there be more abundance of spirits; then the upper parts are also moved, as wel as the legges; whose motion contributeth to defense: but the brain it self, and the senses which are in the head, being the first in the course of this flood of spirits, that is sent from the heart to the head; it is impossible but that some part of them, should be pressed into the nerves of those

senses;

ſenſes; and ſo will make the animal vigilant and attentive to the cauſe of its feare or griefe.

But if the feare be ſo great, that it contracteth all the ſpirits, and quite hindereth their motion (as in the caſe we touched above) then it leaveth alſo the nerves of the ſenſes deſtitute of ſpirits; and ſo by too ſtrong apprehenſion of a danger, the animal neither ſeeth nor apprehendeth it: but as eaſily precipitateth it ſelfe into it, as it happeneth to avoid it; being meerly governed by chance; and may peradventure ſeeme valiant, through extremity of feare.

And thus you ſee in common, how all the natural operations of the body, doe follow by natural conſequence out of the paſſions of the minde: without needing to attribute diſcourſe or reaſon, either to men or beaſts to perform them. Although at the firſt ſight, ſome of them may appeare unto thoſe that look not into their principles & true cauſes, to flow from a ſource of intelligence: whereas it is evident by what we have layed open, they all proceed from the due rangeing and ordering of quantitative parts, ſo or ſo proportioned by rarity and denſity. And there is no doubt, but who would follow this ſeareh deeply, might certainly retrive the reaſons of all thoſe externall motions which we ſee uſe to accompany the ſeverall paſſions in Men and Beaſts. But for our intent, we have ſaid enough, to ſhew by what kind of order and courſe of nature, they may be effected (without confining our ſelves over ſcrupulouſly to every circumſtance that we have touched) and to give a hint, whereby others that will make this inquiry their taske, may compile an intire, and well grounded, and intelligible doctrine of this matter.

Only we will adde one advertiſement more; which is that theſe externall motions cauſed by paſſion, are of two kindes: for ſome of them are as it were the beginnings of the actions, which nature intendeth to have follow out of the paſſions that cauſe them: but others are not onely bare ſignes of paſſion that produce them, and are made by the connexion of parts unneceſſary for the maine action that is to follow out of the paſſion, with other parts that by the paſſion are neceſſarily moved: as for example, when an hungry mans mouth watereth at the ſight of good meate, it is a kinde of beginning of eating, or of prepa-

ration for eating: for when we eate, nature draweth a moysture into our mouth, to humectate our meat, and to convey the taſt of it into the nerves of the tongue, which are to make report of it unto the braine: but when we laugh, the motion of our face aymeth at no further end, and followeth only by the connexion of thoſe muſcles, which draw the face in ſuch a ſort, unto ſome inward parts, that are moved by the paſſion, out of which laughing proceedeth.

8. Of the Diaphragma.

But we muſt not leave this ſubject without ſome mention of the diaphragma: into which the other branch of thoſe nerves, that are called of the ſixt conjugation, doth come: for the firſt branch we have ſaid goeth into the heart, and carrieth thither the objects that come into the braine: and this, we ſhall find, carrieth back to the braine the paſſion or motion, which by the object is rayſed in the heart. Concerning this part of our body, you are to note, that it is a muſculous membrane, which in the middle of it hath a ſinewy circle; whereunto is faſtned the caſe of the heart, called the Pericardium. This Diaphragma is very ſenſible, receiving its vertue of feeling from the above mentioned branch of the ſixt couple of nerves: and being of a trembling nature, is by our reſpiration kept in continuall motion: and flappeth upon all occaſions, as a drum head would do, if it were ſlack and moyſt; or as a ſayle would do, that were brought into the wind.

Out of this deſcription of it, it is obvious to conceive, that all the changes of motion in the heart, muſt needs be expreſſed in the Diaphragma. For the heart beating upon the Pericardium, and the Pericardium being joyned to the Diaphragma; ſuch joggs and vibrations muſt needs be imprinted and echoed there, as are formed in the heart: which from thence, cannot chooſe but be carried to the braine by the ſixt couple of nerves. And thus it commeth about, that we feel and have ſenſation of all the paſſions, that are moved in our heart. Which peradventure is the reaſon, why the Greeks do call this part φρένες; and from it derive the verbe φρονεῖν, that in Latin ſignifyeth *Sapere*, with us, to ſavour or to like: for by this part of our body, we have a liking of any object, or a motion of inclination towards it: from whence σωφρονεῖν is derived, by compoſition of φρονεῖν, with σῶς: for a prudent man is he, that liketh, & is moved

moved to compaſſe wholeſome & good things. Which Etymology of the word, ſeemeth unto me more naturall, then from the phreneſy, from whence ſome derive it; be cauſe a great diſtemper or inflammation in the Diaphragma, often cauſeth that diſeaſe.

9 Concerning pain and pleaſure cauſed by the memory of things paſt.

Now, becauſe the objects is conveyed from the brain to the heart ſome part of its way, by the ſame paſſage, as the motion of the heart is reconveyed back to the brain, it muſt of neceſſity follow, that who is more attentive to outward ſenſe, doth leſſe conſider or reflect upon his paſſion; and who is more atentive to obſerve, and be governed by what paſſeth in his heart, is leſſe wrought upon by externall things. For if his fantaſy draweth ſtrongly unto it, the emanations from outward agents upon the ſenſes, the ſtreame of thoſe emanations will deſcend ſo ſtrongly from the over filled fantaſy into the heart, that it will hinder the aſcent of any fewer and weaker ſpirits by the ſame pipe. But if the current do ſet ſtrongeſt upwards from the heart by the Diaphragma to the braine, then it will ſo fill the pipe by which it aſcendeth, that little of a weaker tyde, can make a contrary ebby water in the ſam channell.

And by this meanes, nature effecteth a ſecond pleaſure or paine in a living creature, which moveth it (oftentimes very powerfully) in abſence of the primary object: as we may obſerve, when thinking of any pleaſing or diſpleaſing action, we find about our heart a motion which inticeth us to it, or averteth us from it: for as the firſt pleaſure was occaſioned by the ſtroak, which the object applyed to the outward ſenſe, made upon the fantaſy (which can judge of nothing without being ſtrucken by it) ſo the ſecond pleaſure ſpringeth from the ſpirits moved in the heart, by meſſengers from the brain, which by the Diaphragma do rebound a ſtroak back again upon the fantaſy. And from hence it proceedeth, that memory delighteth or afflicteth us; and that we think of paſt things with ſweetneſſe or with remorſe: and thereby aſſuefaction is wrought in beaſts, as farre as the appetitive part doth contribute thereunto, to perfect what was begun in their cognoſcitive part, by the ingreſſion of corporeal ſpecieſes into their fantaſy, in order to the ſame effect, as we have touched before.

10 How ſo ſmall bodies as atomes are, can cauſe ſo great motions in the heart.

But now let us examine, how ſo ſmall a quantity of a body as commeth from an object into our ſenſe, can be the cauſe of ſo great a moti-

a motion about our heart. To which purpose we are to remember, that this motion is performed in the most subtile and thin substance, that can be imagined: they are the vitall spirits, that do all this work; which are so subtile, so agile, and so hot, that they may in some sort be termed fire Now if we reflect how violent fire is, we need not wonder at the suddaine and great motion of these passions.

But we must further take notice, that they are not in the greatest excesse, but where the living creature hath been long inured and exercised unto them, either directly or indirectly: so that they arrive not to that pitch so much out of the power of the agent, as out of the preparation and disposition of the patient; as when cold water hath been often heated by extinguishing red hot irons in it, after some repetitions a few quenchings will reduce it from cold to boyling, that at the first would scarce have made it lukewarme: and accordingly we see a hart, that for a long time hath loved, and vehemently hath desired enjoying, is transported in a high degree, at the least sight and remuance of stroaks from its beloved object; and is as much dejected, upon any the last deprivation of it: for to such an object, the living creature is hurried away by a force much resembling the gravity or celerity of a dense body, that is set on running down a steep hill; unto which, the onely taking away of a weake let or the least stop, giveth a precipitate course, not out of the force of what is done to it, but out of the force which was formerly in the thing, though for the present it lay there undiscovered: and so likewise in these cases, the object rather giveth the occasion of the violent motion, then the force or power to it.

How the vitall spirits sent from the brain, doe run to the intended part of the body without mistake.

These things being thus determined, some peradventure may ask, how it commeth to passe, that the spirits which cause motion, being sent on their errant by the braine, do alwayes hit the right way, and light duly into those very sinewes, which move the living creature according as it is requisite for its nature? Since all the passages are open, what is it that governeth them, so as they never mistake, and the animal is never driven towards harme instead of flying from it? Who is their guide in these obscure paths? But it were to impute ignorance to the maker, to think that he framed all the passages alike, and so every one of them,

them, promiſcuouſly apt to receive into them, all ſorts of ſpirits, howſoever they be moved: and therefore, we may aſſure our ſelves that ſince in theſe diverſities of occaſions, there are likewiſe divers kinds of motions from the heart; either there is proportionable unto them, divers kinds of paſſages fit to receive and entertaine the ſpirits according to the condition they are in, ſo as the paſſages which are ajuſted to one kind of ſpirits, will not admit any of an other nature: or elſe the firſt motions of liking or diſliking in the heart, which (as we have ſaid) do cauſe a ſwelling or a contraction of it againſt this or that part; doth ſtop and hinder the entrance of the ſpirits into ſome ſinewes, and doth open others, and driveth the ſpirits into them: ſo as in the end, by a reſult of a chaine of ſwellings and contractions of ſeverall parts ſucceſſively one againſt an other, the due motions of proſecution or averſion are brought about.

As for example; an object that affecteth the heart with liking, by dilating the ſpirits about the heart, ſendeth ſome into the optik nerves, and making the living creature turne his eye towards it and keep it ſteady upon what he deſireth: as contrariwiſe, if he diſlike and feare it, he naturally turneth his eye and head from it. Now, of this motion of the eye and head, may depend the running to the thing in one caſe, and the running from it in the other: for the turning of the neck one way, may open a paſſage for the ſpirits into thoſe ſinewes, which carry the reſt of the body towards the object: and the turning of it to the other ſide, may open other ſinewes, which ſhall work a contrary effect, and carry the animall from the object: and the moving of thoſe ſinewes, which at the firſt do turne the neck; doth proceed from the quality and number of the ſpirits that aſcend from the heart, and from the region of the heart from whence they are ſent: according to the variety whereof, there are divers ſinewes fitted to receive them.

To make up wch diſcourſe, we may call to mind, what we have ſaid a little above concerning the motions cauſed in the external parts of the body, by paſſion moving within: as when feare mingled with hope, giveth a motion to the legs, anger to the armes & hands, and all the reſt of the body as well as to the legs; and all of them, an attention in the outward ſenſes; which nevertheleſs perverteth every one of their functions, if the paſſion be in extremity.

And

And then ſurely, we may ſatisfie our ſelves, that either this, or ſome way like it (which I leave unto the curious in Anatomy to ſettle with exactneſſe; for it is enough for my intent, to ſhew in groſſe how theſe operations may be done, without calling in ſome incomprehenſible qualities to our ayd) is the courſe of nature in motions, where no other cauſe interveneth, beſides the object working upon the ſenſe: which all the while it doth, it is the office of the eye of fantaſie or of common ſenſe, to lie ever open; ſtill watching to obſerve what warnings the outward ſenſes do ſend unto him; that accordingly he may direct and change the motions of the heart, and of the whole body.

How men are blinded by paſſions.

But if the object do make violent impreſſions upon the ſenſe; and the heart, being then vehemently moved, do thereupon ſend abundance of ſpirits up to the brain; this multitude of ſpirits thronging upon the common ſenſe, oppreſſeth it (as we have already ſaid) in ſuch ſort, that the notice which the ſenſe giveth of particular circumſtances, cannot prevaile to any effect in the brain: and thus by the miſguidance of the heart, the work of nature is diſordered: which when it happeneth, we expreſſe in ſhort, by ſaying that paſſion blindeth the creature, in whom ſuch violent and diſorderly motions have courſe; for paſſion is nothing elſe, but a motion of the blood and ſpirits about the heart; and is the preparation or beginning of the animals working; as we have above particularly diſplayed.

And thus you ſee in common, how the circuit is made from the object to the ſenſe; and from it by the common ſenſe and fantaſie, to the heart; and from the heart, back again to the brain; which then ſetteth on work thoſe organes or parts the animal is to make uſe of in that occaſion: and they either bring him to, or carry him from the object, that at the firſt cauſed all this motion, an in the end becommeth the period of it.

THE

THE SIX AND THIRTIETH CHAP.

Of some actions of beasts, that seem to be formall acts of reason, as doubting, resolving, inventing.

1 The order and connexion of the subsequent Chapters.

IN the last Chapter the foundations are layd, and the way is opened, for the discovering how all operations which proceed from nature and passion, are performed among living creatures: and therefore, I conceive, I have there by sufficiently complyed with the obligation of my intention,: which is but to expresse and shew in common, how all the actions of sensible bodies may be reduced to locall motion, and to materiall application of one body unto another, in a like manner (though in a different degree) as those motions which we see in livliest bodies. Yet because among such animals as passe for irrational, there happen some operations of so admirable a straine, as resemble very much the highest effects which proceed from a man: I think it not amisse, to give some further light, by extending my discourse to some more particulars then hitherto I have done; whereby the course and way how they are performed, may be more clearely and easily looked into: and the rather, because I have met with some men, who either wanting patience to bestow on thoughts of this kind so much time as is necessary for the due scanning of them; or else through a promptitude of nature, passing swiftly from the effect they look upon in grosse, to the most obvious seeming cause; do suddenly and strongly resolve, that beasts use discourse upon occasions and are endewed with reason.

This I intend not to do quite in particular, for that were to write the History of every particular animal: but will content my selfe with touching the causes in common; yet in such sort, that the indifferent Reader may be satisfied of a possibility, that these effects may proceed from material causes: and that I have pointed out the way, to those who are more curious, and have the patience and leisure to observe diligently what passeth among beasts, how they may trace these effects from step to step, untill at length they discover their true causes.

To

To begin then; I conceive we may reduce all thoſe actions of beaſts, which ſeem admirable, and above the reach of an irrational animal, unto three or four ſeverall heads. The firſt may be of ſuch, as ſeeme to be the very practice of reaſon, as doubting, reſolving, inventing, and the like. The next ſhall be of ſuch, as by docility or practice, beaſts doe often times arrive unto. In the third place, we will conſider certaine continuate actions of a long tract of time, ſo orderly performed by them, as that diſcourſe and rational knowledge ſeem clearly to ſhine through them. And laſt'y, we will caſt our eye upon ſome others, which ſeem to be even above the reaſon that is in man himſelfe, as the knowing of things which the ſenſe never had impreſſion of before, a preſcience of future events, providences, and the like.

2 From whence proceedeththe doubting of beaſts.

As for the firſt: the doubting of beaſts, and their long wavering ſometimes between objects that draw them ſeverall wayes, and at the laſt their reſolving upon ſome one of them, and their ſteady purſuance of that afterwards; will not be matter of hard digeſtion to him, that ſhall have well reliſhed and meditated upon the contents of the laſt Chapter: for it is evident, that if ſeverall objects of different natures do at the ſame time preſent themſelves unto a living creature, they muſt of neceſſity make divers impreſſions in the heart of it, proportionable unto the cauſes from whence they proceed: ſo that if one of them be a motion of hope, and the other be of feare; it cannot chooſe but follow thence, that what one of them beginneth, the other will preſently break off: by which means it will come to paſſe, that in the beaſts heart there muſt needs be ſuch wavering, as we may obſerve in the ſea, when at the beginning of a tide of flood, it meeteth with a banke that checketh the comming in of the waves, and for a while, beateth them back as faſt as they preſſe upon it; they offer at getting over it, and by and by retire back againe from the ſteepneſſe of it, as though they were apprehenſive of ſome danger on the other ſide; and then againe attempt it a freſh: and thus continue labouring, one while one way, another while another; untill at the length the flood increaſing, the water ſeemeth to grow bolder, and breaketh amaine over the banke, and then floweth on, till it meeteth with another, that reſiſteth it, as the firſt did: and thus you ſee, how the ſea can

doubt

doubt and resolve, without any discoursing. In the like manner it fareth with the heart of a beast (whose motions do steer the rest of the body) when it beateth betwixt hope and fear, or between any other two contrary passions, without requiring any other principles from whence to deduce it, then those we have already explicated.

3 Concerning the invention of Foxes and other beasts.

But now to speak of their invention; I must confesse, that among severall of them, their appeareth so much cunning in laying of their plots (which when they have compassed, they seem to grow careless, and to unbend their intention, as having obtained what with earnestnesse they desired) that one might think they wrought by design, and had a distinct view of an end; for the effecting of which, they used discourse to choose the likeliest means.

To this purpose the subtilties of the fox are of most note. They say he useth to lie as if he were dead; thereby to make hens and ducks come boldly to him. That in the night when his body is unseen, he wil fix his eyes upon poultry, and so make them come down to him from their roost. That to rid himselfe of his fleas that afflict him in summer, he will sink his body by little and little into the water, while the fleas creep up to his head (to save themselves from drowning) and from thence to a bough he holdeth in his mouth; and will then swim away, leaving them there. That to Cosen the badger of his earth, he will pisse in it; as knowing that the rank smell of his urine, will drive the other cleanlier beast to quit it. That when dogges are close upon him, and catching at him, he will pisse upon his taile, and by sirking that up and down, will endeavour (you may beleeve) to make their eyes smart, and so retard their pursuit, that he may escape from them.

And their are particular stories, that expresse yet more cunning then all these: as of a fox, that being sore hunted, hanged himself by the teeth among dead vermin in a warren; untill the dogges were passed by him, and had left him. Of another, that in like distresse, would take into his mouth a broom bush growing upon a steep cliffe on the side hand near his den (which had another way to it, easie enough of accesse) and by help of that, would secure cast himself into his

his hole; whiles the dogges that followed him haſtily, and were ignorant of the danger, would break their necks down the rockes.

It is ſaid, that in Thracia, the Country-people ſo know whether the rivers that are frozen in the winter will bear them, or no, by marking whether the foxes venture boldly over them, or retire after they have layed their eares to the Ice, to liſten whether or no they can hear the noyſe of the water running under it: from whence you may imagine they collect, that if they heare the current of the ſtream, the Ice muſt needs be thin; and conſequently dangerous to truſt their weight unto it.

And to buſie my ſelf no longer with their ſubtilties, I will conclude with a famous tale of one of theſe crafty animals; that having killed a gooſe on the other ſide of the river, and being deſirous to ſwim over with it, to carry it to his den, before he would attempt it (leaſt his pray might prove too heavy for him to ſwim withall, and ſo he might loſe it) he firſt weighed the gooſe with a piece of wood, and then tryed to carry that over the river, whiles he left his gooſe behind in a ſafe place; which when he perceived he was able to do with eaſe, he then came back again and ventured over with his heavy bird.

They ſay it is the nature of the Jacatray to hide it ſelf, and imitate the voice of ſuch beaſts, as it uſeth to prey upon; which maketh them come to him, as to one of their own fellows; and then he ſeiſeth upon them and devoureth them.

The Jaccall that hath a ſubtile ſent, hunteth after beaſts, and in the chaſe, by his barking guideth the lyon, (whoſe noſe is not ſo good) ill they overtake what they hunt; which peradventure would be too ſtrong for the Jaccall; but the Lyon killeth the quarry, and having firſt fed himſelf, leaveth the Jaccall his ſhare: and ſo between them both, by the ones dexterity, and by the others ſtrength they get meat for nouriſhment of them both.

Like ſtories are recorded of ſome fiſhes. And every day we ſee the invention of beaſts to ſave themſelves from catching: as hares, when they are hunted, ſeek alwaies to confound the ſent; ſometimes by taking hedges, other whiles waters; ſometimes running among ſheep and other beaſts of ſtronger ſent; ſome-

ſometimes making doubles, and treading the ſame path over and over; and ſometimes leaping with great jumpes hither and thither, before they betake themſelves to their reſt; that ſo the continuateneſſe of the ſent may not lead dogges to their forme.

Now to penetrate into the cauſes of theſe and of ſuch like actions; we may remember, how we ſhewed in the laſt Chapter, that the beating of the heart worketh two things: the one is, that it turneth about the ſpecies, or little corporeities (ſtreaming from outward objects) which remain in the memory: the other is, that it is alwaies preſſing on to ſome motion or other: out of which it hapneth, that when the ordinary waies of getting victuals, or of eſcaping from enemies, do fail a creature whoſe conſtitution is active; it lighteth ſometimes (though peradventure very ſeldome) upon doing ſomething, out of which the deſired effect followeth; as it cannot chooſe but fall out now and then, although chance onely do govern their actions: and when their action proveth ſuccesfull, it leaveth ſuch an impreſſion in the memory, that whenſoever the like occaſion occurreth, that animal will follow the ſame method; for the ſame ſpecieſes do come together from the memory into the fantaſie. But the many attempts that miſcarry, and the ineffectuall motions which ſtraits do caſt beaſts upon, are never obſerved, nor are their any ſtories recorded of them: no more then in the Temple of Neptune, were kept upon the regiſters, the relations of thoſe unfortunate wretches, who making vowes unto that God in their diſtreſſe, were nevertheleſſe drowned.

4 Of foxes that catch hens by lying under their rooſt, & byg: zirg ug: on them.

Thus peradventure, when the fox ſeeth his labour in chacing the hens, to be to no purpoſe; and that by his purſuit of them, he driveth them further out of his reach; he layeth himſelf down to reſt, with a watchfull eye, and perceiving thoſe ſilly animals to grow bolder and bolder, by their not ſeeing him ſtir, he continueth his lying ſtill, untill ſome one of them commeth within his reach, and then on a ſudden, he ſpringeth up and catcheth her: or peradventure ſome poultry might have ſtrayed within his reach whiles he was a ſleep, and have then wakened him with ſome noiſe they made: and ſo he hapned to ſeiſe upon one of them, without either deſigne or paines taking before-

hand:

hand: by ſuch degrees he might chance to catch one the firſt time: and they being ſetled in his memory, together with the effect; it happened that another time when hunger preſſed him, and ſent up to his brain like ſpirits unto thoſe which aſcended thither whiles he lay watching the hens; theſe ſpirits brought the other from his memory into the fantaſie (in ſuch ſort as we have ſhewed in the laſt Chapter) and ſo drove him to the ſame courſe, untill by frequent repetitions, it became ordinary and familiar with him: and then they that look onely upon the performance of the artifice, are apt to infer the diſcourſe & a deſign of reaſon, out of the orderly conduct of it.

But how can we conceive the fox hath judgement to know when the hen is come within his leap, and accordingly offereth not at her till then; unleſſe we reſort to ſome other principles, then what is yet declared? The anſwer unto this objection I think will not be hard to finde; for if the motion, which the preſence of the object maketh in the heart be proportioned out by nature (as there is no doubt but it is) it will not be ſo great and powerfull, as to make the fox leap at it, untill it be arrived ſo near him, that by his nimbleneſſe he can reach it; and ſo without any ayme, further then by the meer flux of his paſſion conveniently raiſed, he doth the feat: but if his paſſion be too violent, it maketh him miſſe his ayme; as we may frequently obſerve both in men and beaſts: and particularly, when fear preſſeth either of them to leap over a ditch, which being too broad, he lighteth in the middeſt of it.

The ſame watchfulneſſe and deſire to have the pullen, that ſit upon a tree out of his reach, maketh him fix his eyes upon them, when they are at rooſt: and at length either the brightneſſe and ſparkling of them dazleth the birds, and maketh them come down to them, (as flyes do in the night about the flame of a candle; or as fiſhes do to a light in a boats head;) or elſe they are affraid; and their fear increaſing, their ſpirits return to the heart, which thereby is oppreſſed, and their outward parts are bereaved of ſtrength and motion; from whence it followeth neceſſarily, that their footing looſeth their hold faſt, and they tumble down half dead with fear, which happeneth alſo frequently to catts, when they look wiſtly upon little birds, that ſit quietly. Or peradventure, their fear maketh them giddy;

as

as when ſome man looking downe a precipice from a dangerous ſtanding, he falleth by the turning of his braine, though nothing be behind him to thruſt him forwards. Or it may be, ſome ſteame commeth from the Fox, which draweth ſuch creatures to him; as it is reported that a great and very poyſonous Toade will do a Weaſell, who will run about the Toade a great while, and ſtill make his circle leſſer and leſſer, till at length he periſheth in the center, where his foe ſitteth ſtill, and draweth him to him: which he doth in ſuch ſort, as animated Mercury will draw leaf-gold duly prepared, or as the loadſtone attracteth Iron: and yet it is apparent, the Weaſell commeth not with his good will; but that there are ſome powerfull chaines, ſteaming from the body of the Toade, which pluck him hither againſt his liking; for by his motions and running, he will expreſſe the greateſt feare that can be.

From whence proceedth the Foxes invention to ridde himſelfe of Fleas.

The method which Foxes do practice, to ridde themſelves of their fleas (if it be true) is obvious enough for them to fall upon; for in Summer, their fleas together with their thick furred coate, cannot chooſe but cauſe an exceeding great itching and heate in their bodies; which will readily invite them to goe into the water to coole themſelves; as the Merchants at the Iſles of Zante and of Cephalonia told me (when I was there) it was the cuſtome of our Engliſh Dogges (who were habituated unto a colder clime) to runne into the Sea in the heate of Summer, and lie there moſt part of the day, with onely their noſes out of the water, that they might draw breath, and would ſleep there with their heads layed upon ſome ſtone, which raiſed them up, whiles their bodies were covered with the Sea: and thoſe Dogs which did not thus, would in one Summer uſually be killed with heat and Fleas.

Now when the Fox feeleth the eaſe that the coolneſſe of the water affordeth that part of him which ſitteth in it, he goeth further and further; yet would not put himſelfe to ſwim, which is a labour, and would heat him, and therefore he avoideth it; ſo that whiles he thus cooleth himſelfe in ſome ſhady place (for it is naturall unto him, in ſuch an occaſion, to reſort unto the coole ſhade, rather then to lie in the Sunne) and in ſuch there being for the moſt part ſome boughes hanging over the water, it happeneth naturally enough, that he taketh

ſome of the loweſt in his mouth, to ſupport him, and ſave him the labour of ſwimming, whiles he lyeth at his eaſe, ſoaking and cooling himſelfe in the River. By which meanes it commeth to paſſe, that the fleas finding no part of him free from water, do creep up to the bough to reſcue themſelves from drowning: and ſo, when he is cooled enough, he goeth away and leaveth them there. In all which finding a benefit and ſatisfaction, whenſoever the like occaſion bringeth thoſe ſpecies, from his memory into his fantaſie, he betaketh himſelfe to the ſame courſe, and therein finding his remedy, at length it groweth familiar to him.

In the like manner, Thales his mule, that was heavily loaden with Salt, happening to ſtumble, and to fall in a River ſhe was going over, the Salt melted by the water ſoaking into the ſacks and ſo ſhe was eaſed of her burden; which ſucceſſe made her, whenſoever ſhe came to a River, and was troubled with her loading, ſhe would lie downe in the water; and could not be reclaymed from it, till they charged ſacks of wooll upon her back, which growing heavier by their imbibing of water, weaned her from her former crafty habit. By which it is apparent, that it was memory and not judgement, which made her for a while behave her ſelfe ſo ſubtilly.

An explication of two other inventions of Foxes.

For the Foxes driving the Badger from his earth, you will not think it needfull to allow him a forecaſt and deſigne in piſſing in it: but as it is naturall for him, to reſt in a place that he meeteth with fit for that purpoſe; ſo it is for him to piſſe in it, if the liſt takes him whiles he is there; which in all liklyhood it will, if he ſtay any time there, and give a relaxation to all his parts by ſleep.

And when he piſſeth in his taile, and ſhaketh it in the Doggs eyes, it is evident that feare, not craft cauſeth this effect; for it avayleth him little, and therefore is not likely to proceed from judgement. And of the other, it is a naturall effect in all beaſts (when it is violent) to contract their tailes between their legs, and to make their urine come from them, (by compreſſing the ſpirits in their heart, which ſhould ſupport their outward parts, and ſtrengthen their ſphincter muſcle) which their being ſnapped at and ſeiſed upon by the Doggs, ſhaketh from their buſhy tailes (fit to retaine it) and then lighting in the Doggs eyes the

the acrimony of it hurteth them, and maketh them shut their liddes.

The story (if it be true) of the Fox, that to save himself from the Dogs that he heard following him in full cry, did hang by his teeth among dead vermin in a warren, is a very strange one I confesse: but it is conceivable, how fear and weerinesse might cause him to seek a shelter to hide himself: and in so plain a tract of ground as warrens use to be in, without any bush or hill to have recourse unto for reliefe, there appearing nothing but a gallowes hanging full of vermin; his fantasie might be moved (he being able to run no further) to thrust himself among those dead bodies, that he saw rested quietly: and having no way to mingle himself with them, but hanging by his teeth; he might continue in that posture, till the Dogs not suspecting him in the ayr, might run under him, and overshoot the sent: which whiles they cast about to recover, by running to beat the next wood or shelter in view (as is their custome in losses of their chance; unto which they are brought by their masters hunting them in that method at the first) the wily animal stealeth another way, and recovereth himself.

7 Concerning Montagues argument to prove that Dogs make syllogismes.

This overrunning of the sent by Dogs in the earnestnesse of their chace, putteth me in mind of Montagues argument, our of which he will infer, that Dogs use discourse, and do make syllogismes in their hunting: for (saith he) when they have followed their chace down a Lane, that at length divideth it self into three others; they will carefully smell at the first, and at the second, and not finding that it hath gone in either of those, they boldly run upon the third, without ever laying their Noses to the ground; as being assured by their discourse and reason, that since it went not in the two first, and their being but one remaining, it must of necessity have gone there.

But this needeth no other cause, then that their eagernesse of hunting, having made them overshoot the sent, (which for a while remaineth in their noses, after they are parted from the object that caused it) they cast back again (as they are accustomed to be made to do in like occasions by the hunters that train them up) and with their noses they try the ground all the way they go; till comming neer where the chace went indeed, the

sent striketh their Noses (that by this time are grown empty of it) before they come at the place: and then they run amain in pursuit of it with their heads held up (which is their convenientest posture for running) and all the way, the sent filleth them at that distance without their needing to smell upon the Earth, to fetch it from thence.

8 A declaration how some tricks are performed by Foxes, which seem to argue discourse.

That Fox which used to cast himself by the advantage of a bough into his Den, was so closely pursued by the Dogs the first time he ventured upon this feat, that he had not time to go into his Earth (his ordinary retreat, when he is nearer it) by the easie and accessible way; but on the on side, to get thither being strong in his fantasie, and on the other side, the precipice which he had often seen, coming likewise thither from his memory; these two concurring could not choose but make him go warily thither: and in so dangerous a leap, it is natural for him, to help himself by any thing in the way that can advantage him: which happening to be by catching in his mouth a bough that hung over his Den, (the onely suddain means he had to take hold of any thing) and from thence taking as it were a new rise for a second leap, he findeth himself in security: whilst the Dogs unacquainted with the place, run violently on, as in the rest of their chace: and so are upon shabrim of the precipice, before they perceive it; and then it is too late for them to stop their course, and consequently, they break their necks. Which mischief to them the Fox needeth not have in his designe, and accordingly tolle them that way; but chance begetting this deliverance of him at the first, when he was so hard pressed, his memory teacheth him to follow the same course, whesoever the like occasion occurreth.

But how many Foxes do there perish in attempts, which if they succeeded, would have been accounted by slight judgers to be notable subtilties: but miscarrying are esteemed tumultuary motions without designe, caused by that animals fantasie and spirits, when he is in extremity? I remember how upon a time, when I was hunting one, he being hard set, and but a little before the Dogs and the Hunters, caught in his mouth the bough of a crooked Ash-tree, he run up a pretty way; which being in a hedge, he there by hung down along the side of

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the hedge, and when we ſtruck him over the ribs with our poles, he would not quit his hold, (ſo ſtrongly the feare of the Dogs wrought in his fantaſie) till greater blowes knocked him on the head. Which ſheweth evidently that this action, was the effect of chance preſſing his fantaſie to do ſomething; and not any reaſon or diſcourſe providing for his ſafety: as we have already ſaid upon occaſion of the others hanging among the dead vermine in the warren.

Thoſe in Thracia, that will not goe over a frozen River, when the Ice is too thin to beare them, are by there memory, not by their judgement taught to retire; for at other times they have been wetted, when they have heard the noiſe of the ſtreame running under the Ice: or the very running of the water calleth the ſpecieſes of ſwimming out from their memory, along with it into their fantaſie (neither of which is pleaſant to them in the winter) and ſo diſliking the noiſe for the other effects ſake, that uſed to accompany it, they avoyd that which begetteth it, and ſo retire from the River. And the reaſon of their liſtning to the noiſe, proceedeth from the ſpirits, that their paſſion upon apprehenſion of a danger preſſeth into the nerves of their ſenſes, as well as into the other nerves of their braines; which accordingly maketh them ſo vigilant, and attentive, then to outward objects and motions.

9 Of the Jaccatrays invention in calling beaſts to himſelfe

That the Jaccatray, or Hyæna, when he is hungry, ſhould have his fantaſie call out from his memory, the Images of thoſe Beaſts, which uſe to ſerve him in that occaſion, is the ordinary courſe of nature: and that together with thoſe Images, there ſhould likewiſe come along the actions and ſounds which uſed to accompany them, and are lodged together with them in the memory, is alſo naturall; then, as little ſtrange it is, that by his owne voyce he ſhould imitate thoſe ſounds, which at that time doe ſo powerfully poſſeſſe his imagination: and having a great docility in thoſe Organs which forme the voice, like a Parrat he repreſenteth them ſo lively, that the deceived beaſts flock to him, and ſo are caught by him: which at the firſt happeneth by chance, but afterwards by memory, and groweth familiar to him.

10 Of the Jaccals deſigne in ſerving the Lyon.

Nor can we imagine, that the Jaccall hath a deſigne of ſerving the Lyon; but his nature being (like a Dog) to bark when he

he feeleth the ſent hot (which he purſueth for his own ſake) the Lyon that dwelleth in the ſame woods with him, meeteth with the noiſe, and followeth it; and peradventure would kil the Jaccal himſelf, as well as what he hunteth, if he could overtake him: but he being too nimble for the Lyon, keepeth out of his reach; till having wearied the beaſt, he chaceth the Lyon that followeth by the cry, commeth in when he is at a-bay, and ſoon teareth in pieces what the other had not ſtrength enough ſo ſuddainly to maſter, and feedeth himſelf upon the Quarry till he be full. All this while the Jaccal dareth not come neer the Lyon but ſtandeth at a diſtance with fear wayting till he have done, and then after he is gone away, he taketh his turn to feed upon what his ſurly maſter hah left.

11 Of ſeveral inventions of Fiſhes.

The like reaſon it is probable we might find out among thoſe Fiſhes that ſerve one another, if we had the conveniency of obſerving particularly how they behave themſelves; as when the Whale hath ſervice from his litle guide (if the report be true, which is a neceſſary circumſtance to be inſerted in every ſuch tale) and others of the like ſtain.

The ſubtlety of the Torpedo (who hideth himſelf in the mud to benum Fiſhes, that may afterwards ſerve him to feed upon) will not require to have its origine from reaſon, and be done by deſigne; when you ſhall conſider it is natural for ſuch cold Creatures to ſtupifie themſelves: and then the Fiſhes that ſwim within the reach of his benumming faculty, will be ſtayd and frozen there: which becauſe they ſee him not, they apprehend not, till it be too late for them to avoid it: and then when the Torpedo commeth out, he feedeth upon what he findeth lying ready in his way.

And in like manner, the Scuttle-fiſh, when he is in ſtraights of being taken by the Fiſherman, caſteth out a blackneſſe that is within him, and ſo making the water become like Inke, he oftentimes eſcapeth their hands in the darkned Element; which ariſeth from no diſcourſe of his, but fear maketh him voyd this liquor that is in him (as it made the Fox voyd his Urin) and in conſequence thereunto, the effect followeth.

12 A diſcovery of divers things don by Hares, which ſeem to argue diſcourſe.

Laſtly, when Hares do uſe thoſe meanes we have mentioned to confound the ſent, and to ſave themſelves from the dogs

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that hunt them, we may obſerve, that they take therein the readieſt wayes, and the moſt obvious unto ſenſe, to avoid the evill they flie from. For what can be more direct to that effect, then to hide themſelves in hedge bottomes, or in woods? Or to ſwim over a River, when that is the moſt immediate way to runne from the Doggs? And when they are in a plaine, where there is no other ſhelter but flocks of ſheep or heards of deer, what can be more naturall, then for them to hide themſelves among them, and run along with them, till the cry of the approaching hounds fright them away, whileſt thoſe tamer beaſts abide it neerer?

Their doublings backward and forward, may proceed from their feare, that diverteth them ſtill from the way they are in at preſent, till the Doggs comming neer, do put the hare out of thoſe waverings, and do make her run ſtraight away: for they never double but when they are a great way before the Doggs, and do not hear them. Or elſe it may be, that not hearing or ſeeing the Doggs, their feare may be almoſt paſſed; and then the agitation which their ſpirits are in, governeth the motions of their body, and will not let them reſt untill they be more appeaſed, (as you ſee weary people, that at their firſt ceaſing from running, cannot ſit ſtill: the like of which happeneth alſo frequently in the motions of joy or of anger) and ſo it maketh them walk backwards and forwards, in a pace proportionate to the agitation of the ſpirits within: and ſometimes thoſe moved ſpirits doe make them bound and leap to and fro (like the loafe with quick-ſilver, we have hereto fore ſpoken of) as they iſſue from the heart by pulſes and ſtroakes; which happeneth when they begin to ſettle towards reſt. Or elſe peradventure their forme is ſo framed, that if they ſhould get into it otherwiſe then by a jump, they would diſorder ſome part of it, and ſo be unſenced and a cold, or otherwiſe at uneaſe during their repoſe: and therefore their jumping to and fro, before they leap plump in, is to take their aime; not much unlike to Doggs, turning about ſeverall times before they lie down: for hare-finders (who uſe to watch them) ſay they will do thus, though they be not purſued. And thus theſe actions which are imputed to craft, thereby to confound the Doggs, or to wiſedome, to walke themſelves untill they be grown into a

fitting temper to fit ſtill; may all of them be reduced to thoſe materiall and corporeal cauſes, which make them do their other ordinary motions, wherein we find no difficulty.

13 Of a Fox reported to have weighed a Gooſe, before he would venture with it over a River; and of fabulous ſtories in common.

If that of the Foxes weighing his Gooſe, before he would venture to carry it over the River, were plainly true, as it is ſet down; I avow I ſhould be hard ſet to find the principles from whence that diſcretion in him proceeded: but I conceive this tale may be paired with that, which telleth us of an other Fox who having his prey taken from him by an Eagle, brought the next day a new prize in the ſame place, having firſt rolled it in the fire, ſo that ſome burning coales ſtuck upon it; which the Eagle comming againe and ſnatching from him, carried to her Neſt, which was thereby ſet on fire; and the young ones falling down, became the Foxes ſhare, inſtead of what their Dam had robbed him of. Such ſtories ſo quaintly contrived, are fitter for a morall then for a naturall Philoſopher: Æſope may entertaine himſelfe and his diſciples with them; whiles all the reflection I ſhall make upon them, is, that when I hear any ſuch finely ordered tales, I cannot doubt but they are well amended in the relation, by thoſe that tell them: it being the inclination and cuſtome of moſt men, (partly through a deſire of having ſtrange things come from them; and partly out of a care that what they ſay may appeare like truth, and ſo be the eaſier believed:) to add circumſtances beyond the truth of the matter: which increaſing at every new mans relation of the ſame accident (for this humour raigneth very generally) at the length, ſo handſome, and yet ſo ſtrange a tale is compoſed, that the firſt author or teller of it, wondereth at it, as well as others, and cannot diſcerne that his ſtory begot this latter.

Therefore, when one of theſe fine tales is propoſed to ſpeculate upon, and that I have no light to guide me in determining what part of them to allow, and what to reject; I think it better to expect an authentique record of it, then be too haſty at gueſſes: leaving ſuch as pretend ability in reading of Riddles to deſcant of the wayes how ſuch actions may be affected: but for others, that have a ſemblance of truth, or do happen ordinarily, be they at the firſt ſight never ſo like the operations of reaſon, I doubt not but that the cauſes of them may be reduced to

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the principles we have already eſtabliſhed; and the wayes of performing them, may be pitched upon by ſuch diſcourſes about them, as we have made about thoſe examples we have above produced. Eſpecially if the actions themſelves were obſerved by one that could judge of them, and were reported with a deſire of expreſſing the truth nakedly as in it ſelfe it lieth; for divers times it hapneth, that men ſaying nothing but truth, do expreſſe it in ſuch manner, and with ſuch terms, that the ignorant hearer conceiveth the thing quite another way, then indeed it is, meerly for the too emphaticall expreſſions: eſpecially if the relatour himſelfe miſſeth in conceiving the true cauſes of what he reporteth, and ſo expreſſeth it proportionable to thoſe which he apprehendeth.

To conclude then this firſt branch, we ſee how the doubting, the reſolving, the ayming, the inventing, and the like, which we experience in beaſts, may by the veſtigiaes we have traced out, be followed unto their root, as far as the diviſion of rarity and denſity; without needing to repaire unto any higher principle, ſaving the wiſdome of the Orderer and Architect of nature, in ſo admirably diſpoſing and mingling theſe material, groſſe, and lifeleſſe bodies, that ſtrange effect and incomprehenſible unto them, who will not look into their ſeverall joynts, may follow out of them, for the good of the creature in whoſe behalfe they are ſo ordered.

14 Of the ſeveral cryings and tones of beaſts: with a refutation of thoſe authors who maintain them to have compleat languages.

But before we go to the next point, we cannot forbeare mentioning their vanity as well as ignorance, who to purchaſe the eſtimation of deeper knowers of nature, would have it believed, that beaſts have compleat languages, as men have, to diſcourſe with one another in; which they vanted they had the intelligence of. It is true, that in us ſpeaking or talking is an operation of reaſon; not becauſe it is in reaſon; but becauſe it is the work of reaſon, by another inſtrument; & is no where to be found without reaſon; which thoſe irrational Phyloſophers, that pretended to underſtand the language of beaſts, allowed them as well as the ability of talking to one another: but it was becauſe they had more pride then knowledge. Of which rank one of the chief, was Apolloniu, ſurnamed from Thyana; for if he had known how to looke into the nature of beaſts, he would have perceived the reaſon of the divers voyces which the ſame beaſts in divers occaſions formeth.

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This is evident, that an animals lungs and chest, lying so neer as they doe unto his heart, and all voice being made by the breathes comming out of his mouth, and through his windpipe, it must necessarily follow, that by the divers orderings of these instruments, his voyce will become divers; and these instruments will be diversly ordered in him, according to the divers motions of his heart: that is, by divers passions in him (for so we may observe in our selves, that our breath is much changed by our being in passion;) and consequently, as a beast is agitated by various passions, he must needs utter variety of voyces, which cannot chuse, but make divers impressions in other beasts, that have commerce with him, whether they be of the same kind as he is, or of a different: and so we see, that if a Dogg setteth upon a Hogg, the bitten Hoggs cry, maketh an impression in the other Hogs, to come to their fellows rescue, and in other Dogs to run after the crying Hog: in like manner, anger in a Dogg maketh snarling or barking, paine, whining, desire, another kind of barking; and his joy of seeing a person that he useth to receive good by, will break out in another kind of whining. So in a Hen her divers passions work divers kinds of clocking; as when shee seeth a Kite, she hath one voyce, when she meeteth with meat, another; when she desireth to gather her chickens under her wing, a third: and so, upon divers occasions, a divers sound; according to the divers ordering of her vocall instruments by the passion which presseth her heart. So that who would look curiously into the motions of the dispositions of a beasts vocall instrumens, and into the motions of the spirits about his heart (which motion we have shewed is passion) would be able to give account, why every voyce of that beast was such a one, and what motion about the heart it were that caused it.

And as much may be observed in men, who in paines and griefes, and other passions, doe use to break out into those voyces, which we call interjections, and which signifie nothing in the understanding of them that forme them, but to the hearer are signes of the passion from whence they proceed: which if a man do heedfully mark in himselfe, he will perceive that they are nothing else, but the sudain eruptions of a great deale of breath together, caused by some compression made within him, by the paine

pain he is in. Which is the reason that the striving against groanings in certain occasions, doth sick persons much harm; for it disordereth the naturall motions of some principal parts within him, that are already too much agitated; and the counter-motion by which they are checked, putteth them further into a more violent agitation. In the observation of these natural eruptions of mens breath, caused by passion, our forefathers of old were so industrious, as to transferre the imitation of nature in this particular into musick, so that their kinds of musick were distinguished according to the division of mens passions; and by similitude would raise them in the hearers.

Out of this discourse also reason may be given, why birds are more musicall then other creatures, to wit, because they are of a hotter complexion; and therefore, to their bigness, do require more breath and ayr to cool them; and consequently do make more noise, and more variety of it. Likewise, among beasts, dogs are the most vocal of any that converse with us; who by their ready anger appear to be the hottest. Among men, those that are merry, or soon become heated with a little wine, are given to talking or singing: and so are children and women likewise; not so much through abundance of heat as because their heat doth easily vent.

And thus it is evident, that their is no true language among beasts: their voices not being tokens of divers things or conceptions, but meerly the effects of divers breathings, caused by divers passions. Wherefore, since both breathing and passion, are easily reduced to the common principles of rarity and density; we need not trouble our selves any further, to seek into the origine of this vocal faculty of beasts.

THE

THE SEVEN AND THIRTIETH CHAP.

Of the docility of ſome irrational animals; and of certaine continuate actions of a long tract of time ſo orderly performed by them, that they ſeem to argue knowledge in them

How Hawkes and other creatures are taught to doe what they are brought up to.

AS for docility, (which is our ſecond head) Apes and Elephants are moſt famed, Though peradventure, the cunning and obedience of our Hawkes and Dogs, is no whit inferiour to what is reported of them; and would be as much admired, were it not ſo common. I have by ſundry perſons who have ſeen him, been told of a Baboon, that would play certain leſſons upon a Guittare. The Indian hiſtories make mention of Apes, that will go to the Taverne and fetch Wine for their maſters; as Lipſius his Dog would bring his maſter as much meat from the Market, as he carried money to his butcher to pay for. Of Elephants likewiſe, ſtrange things are told: but becauſe we cannot eaſily judge how to underſtand reports, wherefore we have not ſeen the experience, nor how far to believe them, I intend not to inſiſt upon the examining of them; for by looking into the nature and art of our Hounds that follow a ſuite of blood, or that draw dry foot; and of our Hawkes, eſpecially of the decoy Ducks and Cormorants; a ſcantling may be given at all the reſt. And although theſe things told at randome, may juſtly ſeem very admirable to any man the firſt time he heareth of them, yet to him that underſtandeth how they are taught, there is no one paſſage but will appeare plaine enough.

The firſt degree is to tame the Hawke by watching her from ſleep, and to acquaint her with the man by continually carrying her upon his fiſt, and uſing her to take her meat quietly, as ſhe ſitteth upon his hand. Then he maketh her hop a little way to it in a paire of cranes: & after a while, kill a ſeeled pidgeon; from which he taketh her when ſhe is grown ſteady in her leſſon ſo far and feedeth her up with other meat: and thus in time he bringeth her to flie at what he will have her, and to be content with

with a ſmall reward, leaving her quarry to her maſter; ſo that a ſpectatour, who underſtandeth not the myſtery, nor ever ſaw hawking before, may wel admire to ſee a bird ſo dutifully and exactly obey a mans command: and may conceive ſhe hath a reaſonable ſoule, whereby to underſtand him and diſcourſe of the means to bring his purpoſe to effect. Whereas indeed all this is no more, then to make her do for you, and when you pleaſe, the ſame which ſhe doth by nature to feed her ſelf.

The cunning of dogs is begotten in the ſame way. Coyducks are beaten and whipped to what they are taught, like ſetting dogs. Cormorants have their throats tied, that they may not ſwallow the fiſh they catch, but be conſtrained to bring it to the man that imployeth them; ſo that looking along ſtep by ſtep, you ſhall meet with nothing but what is plain and eaſie to be taught, and to be performed by ſenſe and memory; without needing to attribute any diſcourſe or reaſoning unto beaſts.

Apes are likewiſe taught as dogs may be, to carry things to a certain houſe; where receiving what is given them, they return home with it: and you may be confident, this ſerviceableneſſe of the Ape, grew out of his being carried firſt to the tavern by the maid or boy, who there gave him ſomthing that pleaſed him; and then being made to carry the pot along by the boy; and afterward being made to carry money in one hand, and the pot in the other: where of ſome drawer diſcharged him of the one, and filled the other, and withall gave him a reward; which alſo was repeated to him at his return home with his full pot: till at the laſt, when he was ſufficiently uſed to this exerciſe, he would of himſelf go ſtraight thither, as ſoon as he was harneſſed in ſuch ſort as he uſed to be for this ſervice. Which appeareth to be affuefaction and cuſtome, not judgement, by his receiving indifferently whatſoever is put into his pot.

And by the tale of Lipſius his dog; from whom other leſſe dogs, ſnatching as he trotted along, part of what hung out o his basket (which he carried in his mouth) he ſet it down to worry one of them; whiles in the mean time, the others fed at liberty, and at eaſe upon the meat that lay there unguarded: til he coming back to it, drove them away, and himſelf made an end

of

of eating it up. Whereby we may conceive that the ſpecies of carrying his basket to his maſter (which cuſtome had ſetled in his memory) was diſordered, and thruſt out of his fantaſie, by a ſtronger, of fighting for his meat with the other curres: after which it followed naturally in his fantaſie, to eate what he had fought for. And that ſending then ſpirits into his nerves, agreeable to the nature of it, and governing the parts depending of the brain, a motion and action enſued, which was ſutable to the object in the fantaſie; and this could be none other, but of eating what the fantaſie found conformable unto its nature.

2 Of the Baboon that played on a guittarre.

The baboon we have mentioned, might be taught ſome leſſons made on purpoſe with very few ſtops, and upon an inſtrument whereon all the ſtrings may be ſtrucken with one blow, and but one fret to be uſed at a time, and that fret to be ſtopped with one finger; of which much labour and time might beget a habit in him: and then, imitation of the ſound, might make him play in due meaſure. And if we will mark it in our ſelves, we ſhall ſee, that although in the firſt learning of a leſſon upon the Lute, we imploy our reaſon and diſcourſe about it; yet when we have it very perfect, our fingers (guided by a ſlight fantaſie) do fall by cuſtome, without any reflexion at all, to play it as well as if we thought never ſo carefully upon it. And there is no compariſon, between the difficulty of a guittarre and of a lute.

I have been told that at the Duke of Florence his marriage, there was a dance of horſes, in which they kept exact time of muſick. The meanes uſed for bringing them to it, is ſaid to have been by tying and hampering their legs in ſuch ſort, that they could lift them up but in a determinate way: and then ſetting them upon the pavement, that was heated underneath ſo hot that they could not endure to ſtand ſtill, whiles ſuch muſicall ayres were played to them, as fitted their motions. All which being often repeated, the horſes took a habit, that in hearing thoſe ayres, they would lift up their legs in that faſhion; and ſo danced to the the tune they had been taught.

3 Of the teaching of Elephants & other beaſts to do divers tricks.

Of the Elephants, it is ſaid that they may be taught to write; and that purely upon words, and commanding them, they will do what they are bidden; and that they are able to keep ac-

count,

count, and will leave working at a preciſe number of revolutions of the ſame action, which meaſureth out their task unto them. All which (as I ſaid before) if it were plainly and literally true, would require very great conſideration: but becauſe the teachers of beaſts have certain ſecrets in their art, which ſtanders by do not reach unto; we are not able (upon ſuch ſcanty relations as we have of them) to make ſufficient judgement how ſuch things are done; unleſſe we had the managing of thoſe creatures, whereby to try them in ſeveral occaſions, and to obſerve what cauſe produceth every operation they do; and by what ſteps they attaine unto their inſtructions and ſerviceableneſſe.

It is true, the uncontrolled reports of them oblige us to beleeve ſome extraordinary matter of their docility, and of ſtrange things done by them: but withall, the example of other taught beaſts among us; and of the ſtrange judgements that are made of them by perſons, who do not penetrate into their cauſes, may inſtruct us, how eaſie it is to miſtake the matter; and aſſure us, that the relations which are made unto us, do not alwaies punctually agree with the truth of what paſſed. He that ſhould tell an Indian what feats Bankes his horſe would do, how he would reſtore a glove to the due owner, after his maſter had whiſpered that mans name in his eare; how he would tell the juſt number of pence in any piece of ſilver coyne barely ſhewed him by his maſter; and even obey preſently his command, in diſcharging himſelfe of his excrements whenſoever he bad him (ſo great a power art may have over nature:) would make him believe, admire more at this learned beaſt, then we doe at their docile Elephants, upon the relations we have of them. Whereas every one of us knoweth, by what meanes his painfull tutor brought him to doe all his tricks: and they are no whit more extraordinary, then a fawkners manning of a hawk, and training her up to kill Partridges, and to flie at the retrieve: but doe all of them (both theſe, and all other jugling artifices of beaſts) depend upon the ſame, or like principles; and are known to be but directions of nature, ordered by one that compoſeth and levelleth her operations to another end further off (in thoſe actions) then ſhe of her ſelfe would aime at. The partiulars of which, we need not trouble our ſelves to meddle with.

But

4 Of the orderly traine of actions performed by beasts in breeding their young ones.

But it is time that we come to the third sort of actions performed by beasts, which we promised to discourse of. These seem to be more admirable, then any we have yet touched: and are chiefely concerning the breeding of their young ones. Above all others, the orderly course of birds in this affaire, is most remarkable. After they have coupled they make their nest, they line it wih moss, straw, and feathers; they lay their egges, they sit upon them, they hatch them, they feed their young ones, and they teach them to flie: all which they doe with so continuate and regular a method, as no man can direct or imagine a better.

But as for the regularity, orderlines, and continuance of these actions, the matter is easie enough to be conceived: for seeing that the operation of the male, maketh a change in the female; and that this change beginning from the very first, groweth by time into divers proportions: it is no wonder that it breedeth divers dispositions in the female, which cause her to doe different actions, correspondent to those divers dispositions. Now, those actions must of necessity be constant and orderly, because the causes whence they proceed, are such.

But to determine in particular how it commeth to passe, that every change in the female disposeth her to such and such actions, there is the difficulty; and it is no small one: as well, for that there are no carefull and due observations, made of the effect and circumstances which should guide us to judge of their causes; as because these actions are the most refined ones of sensitive creatures; and doe flow from the top and perfection of their nature; and are the last straine of their utmost vigour, unto which all others are subordinate. As in our enquiry into the motions and operations of the bodies of a lower orbe then these, we meet with some (namely the loadstone, and such like) of which it is very hard to give exact and plaine account; the Author of them reserving something from our cleare and distinct knowledge; and suffering us to looke upon it but through a mist: in like manner we cannot but expect, that in the depth of this other perfect nature, there must be somewhat, whereof we can have but a glimmering and imperfect notion. But as in the other, it served our turne to trace out a way, how those operations might be effected by bodies, and by local motion

motion (though peradventure, we did not in every circumstance hit exactly upon the right) thereby to defend our selves from admitting those chymericall qualities, which we had already condemned, upon all other occasions.

So I conceive, it will be sufficient for us in this, to shew how these actions may be done by the senses, and by the motion of corporeal spirits and by material impressions upon them; without being constrained to resort unto an immaterial principle, which must furnish Birds with reason and discourse: in which, it is not necessary for my purpose, to determine precisely every step by which these actions are performed, and to settle the rigorous truth of them: but leaving that unto those, who shall take pains to deliver the history of their nature, I will content my selfe with the possibility and probability of my conjectures. The first of which qualities, I am oblieged to make plain; but the latter concerneth this Treatise no more, then it would do a man to enquire anxiously into the particulars of what it is that a beast is doing, whiles looking upon it at a great distance, he perceiveth plainly that it moveth it selfe: and his arrant is, but to be assured whether it be alive or dead: which the moving of it selfe in common, doth sufficiently demonstrate, without descending into a particular search, of what his motions are.

But let us come to the matter: first I conceive no man will make any difficulty in allowing that it is the temper of the blood and spirits in Birds (brought thereunto by the quality of their food, and by the season of the year) which maketh them couple with one another, and not any ayme or desire of having young ones, that occasioneth this action in them. Then it followeth that the Hens egges will encrease in her belly; and when they grow big, they cannot choose but be troublesome unto her; and therefore must of necessity breed in her an inclination to rest in some soft place, and to be rid of them. And as we see a Dog or a Cat pressed by nature, searcheth about to find a convenient place to disburden themselves in, not onely of their young ones, but even of their excrements; so do Birds, whose egges within them, making them heavy and unfit to flie, they begin to sit much, and are pleased in a soft and warme place: and thereupon they are delighted with straws and mosse, and other gentle sub-

ſtances; and ſo carry them to their fitting place: which that they do not by deſigne, is evident by the manner of it; for when they have met with a ſtraw or other fit material, they flie not with it directly to their neſt, but firſt to a bough of ſome tree, or to the top of a houſe; and there they hop and dance a while with it in their beakes; and from thence skip to another place, where they entertain themſelves in like manner: and at the laſt, they get to their neſt: where if the ſtraw ſhould lie confuſedly, their ends would prick and hurt them: and therefore they turn and alter their poſitions till they lie ſmooth: which we that look upon the effect, and compare them with our performing of like actions (if we had occaſion) may call a judicious ordering of them, whereas in them, it is nothing but removing ſuch things as preſſe upon their ſenſe, untill they cauſe them no more paine or unquietneſſe.

Their plaiſtering of their neſts, may be attributed to the great heat raigning in them at that time; which maketh them ſtill be dabbling in moiſt clay, and in water, and in gravell, (without which, all Birds will ſoon grow ſick, blind, and at length die) which (for the coolneſſe of it) they bring home to their neſts in their beakes and upon their feet; and when it groweth dry, and conſequently troubleſome to them, they wipe it off, and rub their dirty parts upon the place where they uſe to ſit; and then flie for more to refreſh themſelves withall.

Out of all which actions (ſet on foot by the wiſe orderer of nature, to compaſſe a remote end, quite different from the immediate end that every one of them is done for) there reſulteth a fit and convenient place for theſe little builders (that know not what they do, whiles they build themſelves houſes) to lie in, and to lay their egges in. Which the next year, when the like occaſion occurreth, they build again; peradventure then, as much through memory of the former, as upon their temper and other circumſtances moving their fantaſie, in ſuch ſort as we have ſet downe.

In like manner, that whiles the Halcyon layeth and hatcheth her egges, the Sea is calme, needeth no more be attributed to the wiſdome and providence of that Bird, in chooſing a fit ſeaſon, then to any good nature or diſcourſe in that rouling and merci-

leſſe

leſſe Element; as though it had a pious eare of preſerving the egges committed to his truſt: no ſuch ſupplements are requiſite to be added to the diſtributions of nature, who hath ſet material cauſes on foot, to produce a conjecture of both thoſe effects at the ſame period of time, for the propagation of this animals ſpecies.

In fine, both the time and place of the Halcyons breeding, and the manner and order, and reaſon of all Birds making their neſts, proceedeth from ſecret motions, which do require great obſerving and attention to underſtand them; and do ſerve for directions unto every Bird, according to her kind, to make her neſt fitteſt for her uſe. Which ſecret motions, we cannot doubt but are material ones, and do ariſe out of the conſtitution and temper of their bodies and ſpirits; which in like circumſtances are alike in them all: for all the Birds of one kind do make their neſts exactly alike; which they would not do, if this work proceeded from reaſon in them, and were governed by their own election and deſigne: as we ſee it happen among men upon all occaſions, either of building houſes, or of making cloaths, or of what action ſoever is guided by their reaſon governing their fantaſie; in all which we ſee ſo great variety and inconſtancy.

And therefore this invariability in the Birds operations, muſt proceed from a higher intellect, that hath determinately and preciſely ordered a complexe or aſſembly of ſundry cauſes, to meet infallibly and by neceſſity, for the production of an effect that he hath deſigned: and ſo, the Birds are but material inſtruments to performe without their knowledge or reflexion, a ſuperiour reaſons, counſels: even as in a clock, that is compoſed of ſeveral pieces and wheeles, all the parts of it do conſpire to give notice of the ſeveral effluxes and periods of time, which the maker hath ordered it for.

And although this be a work of reaſon and diſcourſe in him, that did ſet it together; yet the inſtrumentall performance of it, dependeth meerly of locall motion, and of the revolutions of bodies, ſo orderly proportioned to one another, that their effects cannot faile; when once the engine is wound up: in like manner then the Bird is the engine of the Artificer, infinitely more perfect, and knowing, and dexterious then a poore clock-

maker; and the plummets which do make it go, are the row and order of cauſes chained together, which by the deſigne of the ſupreme work-man, do bring to paſſe ſuch effects, as we ſee in the building of their neſts, and in doing ſuch other actions, as may be compared to the ſtrikings of the clock, and the ringing of the alarme at due times.

And as that King of China, upon his firſt ſeeing a Watch, thought it a living and judicious creature, becauſe it moved ſo regularly of it ſelfe, and believed it to be dead when it was run out; till the opening of it, and the winding it up, diſcovered unto him the artifice of it: ſo any man may be excuſed, that looking upon theſe ſtrange actions, and this admirable oeconomy of ſome living creatures, ſhould believe them endued with reaſon, untill he have well reflected upon every particular circumſtance of their nature and operations: for then he will diſcern how theſe are but material inſtruments of a rational agent working by them, from whoſe orderly preſcriptions, they have not power to ſwarve in the leaſt circumſtance that is. Every one of which conſidered ſingly by it ſelf, hath a face of no more difficulty, then that (for example) an engineer ſhould ſo order his matters, that a mine ſhould be ready to play exactly at ſuch an hour, by leaving ſuch a proportion of kindled match hanging out of one of the barrels of powder, whiles in the mean time, he either ſleepeth, or attendeth to ſomething elſe.

And when you have once gained thus much of your ſelfe, to agree unto an orderly courſe and generation of any ſingle effect, by the power of a material cauſe working it; raiſe but your diſcourſe a ſtrain higher, and look with reverence and duty upon the immenſity of that provident Architect, out of whoſe hands theſe Maſter-pieces iſſue, and unto whom it is as eaſie to make a chain of cauſes of a thouſand, or of a million of links, as to make one link alone: and then you will no longer ſtick at allowing the whole oeconomy of thoſe actions, to be nothing elſe, but a production of material effects, by a due ranging and ordering of material cauſes.

But let us return to our theam: as we ſee that milk comming into the breaſts of live-bearing female creatures, when they grow very big, heateth and maketh them ſeek the mouthes

mouths of their young ones, to disburthen and coole them: so the carriage and bigneſſe of the egges, heateth exceedingly the breasts and bodies of the birds; and this causeth them to be still rubbing of their breasts against the sides of their nests (whereunto their unwieldineſſe then confineth them very much) and with their beakes to be still picking their feathers; which being then apt to fall off and mew (as we see the haire of women with child, is apt to shed) it happeneth that by then they are ready to lay their egges, they have a soft bed of their own feathers, made in their nests, over their courſer mattrasſe of strawes they first brought thither: and then, the egges powerfull attracting of the anoying heat from the hens breast (whose imbibing of the warmth, and stone-like shell, cannot choose but coole her much) inviteth her to sit constantly upon them, untill sitting hatcheth them; and it is evident, that this sitting must proceed from their temper at that time, or from some other immediate cause, which worketh that effect, and not from a judgement that doth it for a remote end: for houſewifes tell us, that at such a season, their hens will be sitting in every convenient place they come unto, as though they had egges to hatch, when never a one is under them: so as it seemeth that at such time, their is some inconvenience in their bodies, which by sitting is eased.

When the chickens are hatched, what wonder is it, if the litle crying of tender creatures, of a like nature and language with their dammes, do move those affections or passions in her bosome, which causeth her to feed them, and to defend, and breed them, till they be able to shift for themselves? For all this, their needeth no diſcourſe or reason; but onely the motion of the blood about the heart (which we have determined to be passion) stirred by the young ones chirpings, in such sort, as may carry them unto those actions which by nature (the supreame intellect) are ordered for their preservation. Wherein the birds (as we have already said) are but passive instruments, and know not why they do those actions: but do them they must, whensoever such and such obje&s (which infallibly work in their due times) do make such and such impreſſions upon their fantasies, like the allarum that neceſſarily striketh, when

the hand of the dial commeth to ſuch a point; or the gun-powder, that neceſſarily maketh a ruine and breach in the wall, when the burning of the match reacheth to it.

Now this love in the dam, growing by little and little wearisome and troubleſome to her; and at laſt, fading quite away; and ſhe not being able to ſupply their encreaſed needs, which they grow every day ſtronger to provide for of themſelves; the ſtrait commerce beginneth to dye on both ſides: and by theſe degrees the dam leaveth her young ones to their own conduct.

And thus you ſee how this long *ſeries* of actions, may have orderly cauſes, made and chained together, by him that knew what was fitting for the work he went about. Of which though it is likely I have miſſed of the right ones (as it cannot chooſe but happen in all diſquiſitions, where one is the firſt to breake the Ice, and is ſo ſlenderly informed of the particular circumſtances of the matter in queſtion, as I profeſſe to be in this) yet I conceive this diſcourſe doth plainly ſhew, that he who hath done more then we are able to comprehend and underſtand; may have ſet cauſes ſufficient for all theſe effects, in a better order and in compleater ranks, then thoſe which we have here expreſſed: and yet in them ſo courſely hewed out, appeareth a poſſibility of having the work done by corporeal agents. Surely it were very well worth the while, for ſome curious and judicious perſon, to obſerve carefully and often, the ſeveral ſteps of nature in this progreſſe: for I am ſtrongly perſwaded, that by ſuch induſtry, we might in time arrive to very particular knowledge of the immediate and preciſe cauſes, that work all theſe effects. And I conceive, that ſuch obſervation needeth not be very troubleſome; as not requiring any great variety of creatures to inſtitute it upon; for by marking carefully all that paſſeth among our homebred hens, I believe it were eaſie to gueſſe very nearely at all the reſt.

THE

THE EIGHT AND THIRTIETH CHAPTER.

Of prescience of future events, providences, the knowing of things never seen before; and such other actions, observed in some living creatures; which seem to be even above the reason that is in man himselfe.

THE fourth and last kind of actions, which we may with astonishment observe among beasts, I conceive will availe little to infer out of them, that the creatures which do them, are endewed with reason and understanding: for such they are, as if we should admit that, yet we should still be as far to seek for the causes whence they proceed. What should move a lamb to tremble at the first sight of a Woolfe? or a hen at a kite never before seen? neither the grimmest Mastiffe, or the biggest owle, will at all affright them.

1 Why beasts are afraid of men.

That which in the ordinary course of nature, causeth beasts to be afraid of men, or of other beasts, is the hurt and the evil they receive from them: which comming into their fantasie, together with the Idea of him that did it, is also lodged together with it in the memory; from whence they come linked or glewed together, whensoever the stroake of any new object calleth either of them back into the fantasie. This is confirmed by the tamenesse of the birds and beasts, which the first discoverers of Islands not inhabitated by men, did finde in those they met withall there. Their stories tell us, that at their first arrivall upon those coasts, where it seemeth men had never been, the birds would not flie away, but suffered the mariners to take them in their hands: nor the beasts, which with us are wild, would run from them; but their discourteous guests used them so hardly, as they soon changed their confidence into distrust and aversion; and by little they grew, by their commerce with men, and by receiving injuries from them, to be as wild, as any of the like kind in our parts.

From the dammes and fires, this apprehension and fear at

the ſight of men, ſo deeply rooted in them, is doubtleſſely tranſmitted to their young ones; for it proceedeth out of the diſpoſition of the body, & out of the paſſion which is immediately made in the heart; and that is as truly a materiall motion, as any what ſoever can be; and muſt have ſetled materiall inſtruments fitted to it, if it be conſtant, as well as any other natural operation whatſoever: and this paſſion of the heart proceedeth again from a perpetuall connexion of the two objects in the memory: which being a perpetuall conſtant thing, is as true a quality of that beaſts brain in whom it is, as the being of a quick or dull apprehenſion, or the being apt to know one kind of meat from another (which is naturall to the whole ſpecies) or any other quality whatſoever, reſiding in that beaſt.

2 How ſome qualities cauſed at firſt by change in beaſts, may paſſe by generation to the whole offſpring.

Wherefore it is no wonder, that it paſſeth by generation to the offſpring: which is a thing ſo common, even in mankind as there can be no doubt of it: and is at the firſt made by a violent cauſe, that greatly altereth the body: and conſequently their ſeed muſt be imbrewed with a like diſpoſition; and ſo it paſſeth together with the nature of the fire, or of the dam, into the brood. From hence proceedeth, that children do love the ſame meats, and exerciſes, that their fathers and mothers were affected with, and feare the like harmes.

This is the reaſon, why a grand-child of my Lord of *Dorſet* (whoſe honoured name muſt never be mentioned by me without a particular reſpect, and humble acknowledgement of the noble & ſteady friendſhip, he hath ever been pleaſed to honour me with) was alwayes extreamly ſick, if but the Nurſe did eat any Capers (againſt which my Lords antipathy is famous) whiles ſhe gave ſuck to that pretty infant. The Children of great Mathematicians, who have been uſed to buſie their fantaſies continually with figures and proportions, have been oftentimes obſerved, to have a naturall bent unto thoſe Sciences. And we may note that even in particular geſtures, and in little ſingularities in familiar converſation, children will oftentimes reſemble their parents, as well as in the lineaments of their faces. The young ones of excellent ſetting dogges, will have a notable aptitude to that exerciſe; and may be taught with

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halfe the paines, that their ſire or dam was, if they were choſen out of a race of ſpaniels not trained to ſetting. All which effects can proceed from no other cauſe, but (as we have touched already) that the fantaſie of the parent, altereth the temper and the diſpoſition of his body and ſeed, according as it ſelf is tempered and diſpoſed: and conſequently, ſuch a creature muſt be made of it, as retaineth the ſame qualities: in ſuch ſort as it is ſaid that ſufficient tartar put at the root of a tree, will make the fruit have a winy taſt.

3 How the parents fantaſie doth oftentimes worke ſtrange effects in their iſſue.

But nothing doth confirme this ſo much, as certain notable accidents, whereof though every one in particular would ſeem incredible, yet the number of them, and the weight of the reporters, who are the witneſſes, canot chooſe but purchaſe a generall credit to the kind of them. Theſe accidents are, that out of ſome ſtrong imagination of the parents, but eſpecially of the mother, in the time of conception, the children draw ſuch main differences, as were incredible, if the teſtifying authority were not ſo great: but being true, the convince beyond all queſtion the truth we have propoſed, of the parents imagination working upon, and making an impreſſion in the ſeed, whereof children or young ones of their kind are made. Some children of white parents are reported to have been black upon occaſion of a black moores picture too much in the mothers eye. Others are ſaid to have been born with their skins all hairy, out of the ſight of St. *John Baptiſts* picture as he was in the deſart, or of ſome other hairy image. Another child is famed to have been born deformed, in ſuch ſort as Divels are painted, becauſe the father was in the Divels habit when he got the child.

There was a Lady a kinſwoman of mine, who uſed much to weare black patches upon her face (as was the faſhion among young women) which I to put her from, uſed to tell her in jeſt that the next child ſhe ſhould go with, whiles the ſollicitude and care of thoſe patches was ſo ſtrong in her fantaſie, would come into the world with a great black ſpot in the midſt of its fore-head: and this apprehenſion was ſo lively in her imagination at the time ſhe proved with child, that her daughter was b[illegible] marked juſt as the mother had fanſied, which there

there are at hand witneſſes enough to confirme; but none more pregnant, then the young Lady her ſelf, upon whom the mark is yet remaining. Among other creatures, it is ſaid that a hen hatched a chicken with a Kites bill, becauſe ſhe was frighted with a Kite whiles the Cock was treading her. The ſtory of *Jacobs* ſheep is known to all: and ſome do write, that the painting of beautifull coloured pidgeons in a dove-houſe, will make the following race become like them: and in Authors ſtore of ſuch examples may be found.

To give a reaſonable and fully ſatisfying cauſe of this great effect, I confeſſe is very difficult; ſeeing that for the moſt part, the parents ſeed is made long time before the accoupling of the male and female: and though it were not, we ſhould be mainly to ſeek for a rational ground to diſcourſe in particular upon it. Yet not to leave our Reader without a hint which way to drive his inquiſition, we will note thus much, that Ariſtotle and other naturall Philoſophers and Phyſitians do affirme, that in ſome perſons the paſſion is ſo great in the time of their accoupling, that for the preſent it quite bereaveth them of the uſe of reaſon; and that they are for the while in a kind of ſhort fit of an epilepſie. By which it is manifeſt, that aboundance of animal ſpirits do then part from the head, and deſcend into thoſe parts which are the inſtruments of generation. Wherefore, if there be aboundance of ſpecieſes of any one kind of object then ſtrong in the imagination, it muſt of neceſſity be carried down together with the ſpirits in to the ſeed: and by conſequence, when the ſeed infected with this nature, beginneth to ſeperate & diſtribute it ſelf, to the forming of the ſeverall parts of the Embryon, the ſpirits which do reſort into the brain of the child (as to their proper Element) and from thence do finiſh all the outward caſt of its body (in ſuch ſort as we have above deſcribed) do ſometimes happen to fill certaine places of the childes body, with the infection and tincture of this object; and that according to the impreſſion with which they were in the mothers fantaſie: for ſo we have ſaid, that things which come together into the fantaſie, do naturally ſticke together in the animal ſpirits. The hairineſſe therefore will be occaſioned in thoſe parts, where the mother [illegible]fied it to

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be: the colour likewiſe, and ſuch extancies or defects, as may any way proceed from ſuch a cauſe, will happen to be in thoſe parts, in which they were fanſied. And this is as farre as is fit to wade into this point, for ſo generall a diſcourſe as ours is; and more then was neceſſary for our turne: to the ſerving whereof, the verity of the fact onely, and not the knowledge of the cauſe, was required: for we were to ſhew no more, but that the apprehenſions of the parents, may deſcend to the children.

Out of this diſcourſe, the reaſon appeareth, why beaſts have an averſion from thoſe who uſe do them harme: and why this averſion deſcendeth from the old ones to their brood; though it ſhould never have happened that they had formerly encountered with, what at the firſt ſight they flye from and avoid.

But yet the reaſon appeareth not, why (for example) a ſheep in England (where there are no wolves breed, nor have been theſe many ages) ſhould be afraid, and tremble at ſight of a Wolfe, ſince neither he, nor his damme or ſire, nor theirs in multitudes of generations, ever ſaw a wolfe, or received hurt by any. In like manner, how ſhould a tame weaſel brought into England from Iceland (where there are no poyſonous creatures) be afraid of a toad as ſoon as he ſeeth one? Neither he nor any of his race, ever had any impreſſions following harme, made upon their fantaſies: and as little can a Lyon receive hurt from a houſhold Cock: therefore we muſt ſeek the reaſons of theſe and ſuch like antipathies a little further and we ſhall finde them hanging upon the ſame ſtring, with ſympathies proportionable to them. Of Antipathies.

Let us go by degrees: we daily ſee that dogges will have an averſion from Glovers, that make their ware of dogs skins: they will barke at them, and be churliſh to them, and not endure to come neer them, although they never ſaw them before. The like hatred they will expreſſe to the dog killers in the time of the plague, and to thoſe that flea dogs. I have known of a man that uſed to be imployed in ſuch affaires, who paſſing ſometimes over the grounds neer my mothers houſe (for he dwelled at a village not farre off) the dogs would

would wind him at a very great distance, and would all runne furiously out the way he was, and fiercely fall upon him; which made him go alwayes well provided for them: and yet he hath been sometimes hard put to it, by the fierce Mastifes there, had it not been for some of the servants coming in to his rescue; who by the frequent happening of such accidents were warned to look out when they observed so great commotion and fury in the dogges, and yet perceived no present cause for it. Warreners observe, that vermin will hardly come into a trap wherein another of their kind hath been lately killed: and the like happeneth in Mouse-traps, into which no Mouse will come to take the baite, if a Mouse or two have already been killed in it; unlesse it be made very cleane, so that no scent of them remain upon the trap: which can hardly be done on the sudden otherwise then by fire.

It is evident, that these effects are to be referred to an activity of the object upon the sense; for some smell of the skinnes, or of the dead dogges, or of the vermine, or of the Mice, cannot choose but remain upon the men and upon the traps; which being altered from their due nature and temper; must needs offend them. Their conformity on the one side (for something of the canine nature remaineth) maketh them have easie ingression into them; and so they presently make a deep impression: but on the other side, their distemper from what they should be, maketh the impression repugnant to their nature, and be disliked by them, and to affect them worse, then if they were of other creatures, that had no conformity with them: as we may observe, that stinkes offend us more, when they are accompanied with some weak perfume, then if they set upon us single; for the perfume getteth the stinke easier admittance into our sense: and in like manner, it is said that poysons are more dangerous, when they are mingled with a cordiall that is not able to resist them: for it serveth to convey them to the heart, though it be not able to overcome their malignitie.

From hence then it followeth, that if any beast or bird do prey upon some of another kind, their will be some smell about them; exceedingly noysome to all others of that kind;

and

and not onely to Beasts of that same kinde; but (for the same reason) even to others likewise, that have a correspondence and agreement of temper and constitution with that kinde of Beast, whose hurt is the original cause of this aversion. Which being assented unto, the same reason holdeth to make those creatures, whose constitutions and tempers do consist of things repugnant and odious to one another, be at perpetual enmity, and flye from one another at the first sight, or at the least, the sufferer from the more active creature: as we see among those men, whose unhappy trade and continuall exercises it is to empty jakeses, such horrid stinkes are by time grown so conformable to their nature, as a strong perfume will as much offend them, and make them as sick, as such stinkes would do another man bred up among perfumes: and a cordial to their spirits, is some noysome smell, that would almost poyson another man. And thus, if in the breath of the Wolfe, or in the steame comming from his body, be any quality offensive to the Lamb (as it may very well be, where there is so great a contrariety of natures) it is not strange, that at the first sight and approach of him, he should be distempered and flye from him; as one Fighting Cock will do from another, that hath eaten Garlick: and the same happeneth between the Weasel and the Toad, the Lyon and the Cock, the Toad and the Spider, and several other creatures, of whom like enmities are reported.

All which are caused in them, not by secret instincts, and antipathies, and sympathies, wherof we can give no account, (with the bare sound of which words, most men do pay themselves, without examining what they mean;) but by downright material qualities, that are of contrary natures (as Fire and water are) and are either begotten in them in their original constitution, or are implanted in them afterwards by their continual food, which nourishing them, changeth their constitution to its complexion. And I am perswaded this would go so far, that if one man were nourished continually with such meat (and greedily affected with it) which another had aversion from, there would naturally follow much dislike between them; unlesse some superiour regard should master this

this averſion of the ſenſe. And I remember to have ſeen two notable examples of it: the one in Spain, of a Gentleman that had a horror to Garlick, who (though he was very ſubject to the impreſſions of beauty) could never weane himſelfe from an averſion, he had ſetled him to a very handſome woman, that uſed to eat much Garlick; though to win him, ſhe forbore the uſe of that meat, which to her was the moſt ſavoury of all others. And the like I knew in England between two, whereof the one did extreamly love cheeſe, and the other as much hated it, and would fall into a ſtrange agony, and be reduced (one would think) to the point of death, if by inadvertence or others tryall of him, he had ſwallowed never ſo little, of what the other would have quitted all meates elſe to live upon.

And not onely ſuch averſions, as ſpring from differences of complexions in the conſtitutions of ſeveral animals, do cauſe theſe effects of feare, and of trembling, and of flying from thoſe that do make ſuch impreſſions; but even the ſeeing them angry and in fury doth the like: for ſuch paſſions do alter the ſpirits; and they iſſuing from the body of the animal in paſſion, cannot chooſe but be received by another in a different manner, then if they were of another temper. Then if the one kind be agreeable to their nature; the other muſt needs be diſpleaſing. And this may be the reaſon why Bees never ſting ſuch as are of a mild and gentle diſpoſition; & will never agree with others, that are of a froward and angry nature. And the ſame one may obſerve among Dogs: and peradventure, a mans fantaſie may be raiſed to ſuch a height of fury, that the fierceſt Beaſts may be afraid to look upon him; and cannot endure that thoſe maſtering ſpirits, which ſtreame out of the Mans eyes, ſhould come into his; ſo much they diſtemper his fantaſie: and therefore he will turne away from the man and avoid him. Which diſcourſe may be confirmed by ſundry examples of Lyons, and Beares, that have run from angry and confident Men, and the like. Since then that a Man that is in his natural hew giveth no diſtaſt, doth ſo much affright fierceſt Beaſts, when he putteth his threatning lookes, it is no wonder, that Beaſts of a milder and ſofter nature, ſhould have feare of

him

him ſettled in them, when they never ſaw him otherwiſe then angry, and working miſchief to them. And ſince their brood do receive from their parents, a nature eaſily moved unto feare or anger, by the ſight of what moved them, it is not ſtrange, that at the firſt ſight they ſhould tremble or ſwell, acording as the inward motion of the ſpirits affordeth.

Now if this hath rendered the Birds in the wilde Iſlands afraid of Men, who otherwiſe would be indifferent to them, it is no marvaile to ſee more violent effects in the Lambes averſion from the Wolfe, or in the Larkes from the Hobbey; ſince they peradventure have over and above the hurt they uſe to do them, a deformity in their conſtitutions: and therefore, though a Lark will flie as well from a Man as from a Hobbey, yet becauſe there is one cauſe more for his diſlike againſt the Hobbey, then againſt the Man (namely the deformity of their conſtitutions) he will flie into the Mans hand, to avoid the Hawkes talons.

5 Of ſympathies.

Unto ſome of theſe cauſes all antipathies may be reduced: and the like reaſon may be given for the ſympathies we ſee between ſome creatures. The little corporeities which iſſue from the one, have ſuch a conformity with the temper of the other, that it is thereby moved to joyn it ſelfe unto the body from whence they flow, and affecteth union with it in that way, as it receiveth the impreſſion. If the ſmell do pleaſe it, the Beaſt will alwayes be ſmelling at it: if the taſt, nothing ſhall hinder it from feeding upon it when it can reach it. The Fiſher-men upon the bank over againſt New-found-Land, do report that there flocketh about them a kinde of Bird, ſo greedy of the Fiſhes livers which they take there, as that to come at them and feed upon them, they will ſuffer the Men to take them in their hands; and will not flie away, as long as any of their deſired meat is in their eye: whence the French men that fiſh there, do call them *Happe foyes*. The like power a certaine Worme hath with Nightingales.

And thus you ſee, how they are ſtrong impreſſions upon ſenſe, and not any diſcourſe of reaſon, that do govern beaſts in their actions: for if their avoiding Men, did proceed from any ſagacity in their nature: ſurely they would exerciſe it, when they ſee

see that for a bit of meat they incurre their destruction: and yet neither the example of their fellowes killed before their eyes in the same pursuite, nor the blowes which themselves do feel; can serve them for warning, where the sense is so strongly affected: but as soon as the blow that removed them is passed, (if it misse killing or laming them) and they be gotten on wing again, they will returne to their prey as eagerly and as confidently, as if nothing were there to hinder them.

6 That the antipathy of beasts towards one another, may be taken away by assuefaction.

This then being the true reason of all sympathy and antipathy, we cannot admit that any beasts should loue or hate one another, for any other cause, then some of those we have touched. All which are reduced to local motion, and to material application of bodies of one nature, to bodies of another; and are as well transmitted to their young ones, as begotten in themselves: and as the satisfying of their sense, is more prevalent in the *Happe foyes*, then the feare which from other grounds is begotten in their fantasie; and so maketh them approach to what the other would drive them from.

In like manner, any aversion of the fantasie may be mastered not onely by a more powerfull agent upon the present sense, but also by assuefaction, and by bringing into the fantasie with pleasing circumstances that object which before was displeasing and affrightfull to it: as we see that all sorts of Beasts or Birds, if they be taken young may be tamed and will live quietly together. Doggs that are used to hunt and kill Deer, will live friendly with one that is bred with them; and that Fawn which otherwise would have bin affraid of them, by such education, groweth confident and playeth boldly with them. Of which we can no longer remain in doubt, if we will believe the story of a Tyger (accounted the cruellest Beast of all others) who being shut up with a Deer, that had bin bred with him from a Kid, and from his being a whelpe; and no meate given him, used meanes to break Prison, when he was half starved, rather then he would hurt his familiar friend. You will not suspect, that it was a moral consideration, which made him so kinde: but the Deer had never come into his fantasy

taſie accompanied with other circumſtances, then of play or of warmth: and therefore hunger (which calleth onely the ſpecies of meat out of the memory into the fantaſie) would never bring the Deere thither, for remedy of that paſſion.

And that which often happeneth to thoſe men, in whom the fantaſie onely worketh, is not much unlike to this: among whom I have ſeen ſome frenticke perſons, that if they be perſwaded they are tyed, and cannot ſtirre from the place where they are; the will lye ſtill, and make great complaints for their impriſonment; and not go a ſtep, to reach any meat or drink, that ſhould lye in ſight neare them, although they were never ſo much preſſed with hunger or with thirſt. The reaſon is evident, for the apprehenſion of being tied, is ſo ſtrong in their fantaſie, that their fantaſie can ſend no ſpirits into other parts of their body, whereby to cauſe motion.

And thus the Deere was beholding to the Tigars fantaſy, not to his diſcourſe of morall honeſty, for his life. The like of this Tigar and Deere, is to be ſeen every day in the tower of London; where a little dog, that was bred with a Lyon from his birth, is ſo familiar and bold with them, that they not onely ſleep together, but ſometimes the dog will be angry with him, and will bite him; which the Lyon never reſenteth from him, though any other dog that is put to him, he preſently teareth in pieces.

And thus we plainely ſee, how it commeth about, that beaſts may have ſtrange averſions from things, which are of annoying or deſtructive nature to them, even at the firſt ſight of them: and again, may have great likings of other things, in a manner contrary to their nature, without needing to allow them reaſon, whereby to diſcourſe and judge what is hurtfull to them, or to inſtruct the Tigar we have ſpoken of, or Androdus his Lyon, the duties of friendſhip and of gratitude.

7 Of longing markes ſeen in children.

The longing markes which are often times ſeen in children, and do remaine with them all their life, ſeem to be an offſpring of the ſame root or cauſe: but in truth, they proceed from another, although of kinne to this: for the operation of the ſeed is paſſed, when theſe longing markes are imprinted;

the child being then already formed and quickned; and they ſeem to be made ſuddenly, as by the print of a ſeale. Therefore to render the cauſe of them, let us conſider another ſympathy which is more plain & common. We ſee that the laughing of one man, will ſet another on laughing that ſeeth him laugh, though he know not the cauſe why the firſt man laugheth: and the like we ſee in yawning and ſtretching, which breedeth the like effect in the looker on. I have heard of a man, that ſeeing a roaſted pigge, after our Engliſh faſhion with the mouth gaping, could not ſhut his own mouth as long as he looked upon the pigges: and of another that when he ſaw any man make a certaine motion with his hand, could not chooſe but he muſt make the ſame: ſo that being a tyler by his trade, & having one hand imployed with holding his tooles, whiles he held himſelf with the other upon the eaves of the houſe he was mending, a man ſtanding below on the ground, made that ſign or motion to him; whereupon he quitted his hold faſt to imitate that motion, and fell down, in danger of breaking his necke.

All theſe effects, do proceed out of the action of the ſeen object upon the fantaſie of the looker on: which making the picture or likeneſſe of its own action in the others fantaſie, maketh his ſpirits run to the ſame parts; and conſequently, move the ſame members, that is do the ſame actions. And hence it is, that when we heare one ſpeak with love and tenderneſſe of an abſent perſon, we are alſo inclined to love that perſon, though we never ſaw him, nor heard of him before: and that whatſoever a good Oratour delivereth well, (that is, with a ſemblance of paſſion agreeable to his words) raiſeth of its own nature, like affection in the hearers: and that generally men learn and imitate (without deſigne) the cuſtomes and manners of the company they much haunt.

To apply this to our intent, it is eaſie to conceive, that although the child be in the mothers wombe, can neither ſee nor heare what the mother doth, never the leſſe their cannot paſſe any great or violent motion in the mothers body, whereof ſome effect doth not reach unto the child, which is then, one continuate piece with her: and the proper effect of motion or

of

of trembling in one body, being to produce a like motion or a trembling in another, (as we see in that ordinary example of tuned strings, whereof the one is moved at the striking of the other, by reason of the stroak given to the ayr, which finding a moveable easily moved with a motion of the same tenour, communicateth motion unto it) it followeth that the fantasie of the child, being as it were well tuned to the fantasie of the mother, and the mothers fantasie making a speciall and a very quick motion in her own whole body, (as we see that sudden passions do) this motion or trembling of the mother must needs cause the like motion and trembling in the child, even to the very swiftnesse of the mothers motion. Now as we see when one blusheth, the blood cometh into his face, so the blood runneth in the mother to a certaine place, where she is strucken by the thing longed for: and the like happening to the child, the violence of that sudden motion, dyeth the mark or print of the thing in the tender skin of it: the blood in some measure piercing the skin, and not returning wholly into its naturall course: which effect is not permanent in the mother, because her skin being harder, doth not receive the blood into it, but sendeth it back again, without receiving a tincture from it.

8 Why divers men hate some certaine meats & particularly cheese.

Farre more easie is it, to discover the secret cause of many antipathies or sympathies, which are seen in children, and endure with them the greatest part, if not the whole terme of their life, without any apparent ground for them: as some do not love cheese, others garlike, others ducks, others divers other kindes of meat, which their parents loved well; and yet in token that this aversion is naturall unto them, and not arising from some dislike accidentally taken & imprinted in their fantasie, they will be much harmed if they chance to eate any such meat; though by the much disguising it, they neither know, nor so much as suspect they have done so. The story of the Lady *Hennage* (who was of the bed-chamber to the late Queene *Elizabeth*) that had her cheek blistered by laying a rose upon it whiles she was a sleep, to try if her antipathy against that flower, were so great as she used to pretend, is famous in the Court of England. A Kinsman of mine, whiles he

he was a child, had like to have died of drought, before his nurse came to understand, that he had an antipathy against Beer or Wine; untill the tender nature in him, before he could speak, taught him to make earnest signes for water, that by accident he saw; the greedy drinking of which, cured presently his long languishing and pining sickness: and such examples are very frequent.

The cause of these effects many times is, that their mothers, upon their first suppression of their usuall evacuations, by reason of their being with child took some strong dislike to such things, their stomacks being then oppressed by unnatural humors, which overflow their bodies upon such retentions; and which make them oftentimes sick and prone to vomiting, (especially in the mornings, whiles they are fasting) and sometimes to desire earnestly (which they call *longing*) to feed upon some unwholesome, as well as some particular wholesome things; and other whiles, to take aversion against meates, which at other seasons they affected well. Now the child being nourished by the so imbued blood of the mother, no wonder if it taketh affections or dislikes, conformable to those which at that present raigne in the mother: the which for the most part used to be purged away, or are overwhelmed by the mastring qualities of better aliments succeeding: but if by some mischance, they become too much grafted in the childs stomack, or in some other part, through which the masse of blood must passe; then the child getteth an aversion from those meates: and we often see, that people retain a strong conversion to such meates or drinks, as their mothers affected much or longed for, whiles they bred child of them.

And thus we will leave this particular; adding only one note, why there are more persons generally, who have antipathy against cheese, then against any one sort of meat besides whatsoever. A principall reason of which symptome (where the precedent one hath not place) I conceive to be that their nurses prov'd with child, whiles they gave them suck: for I have by experience found it to have bee so, in as many as I have made inquiry into. And it is very conformable to reason; for the nurses milk, curdling in her breast upon her breeding of child, & becomming very offensive to the childes tender stomack, (whose being sick, obligeth,

obligeth the parents to change the Nurſe, though peradventure they know nothing of the true reaſon that maketh her milke unnaturall) he hath a diſlike of Cheeſe (which is ſtrong curdled milk) ever after ſettled in him; as people that have once ſurfeited violently of any meat, ſeldome arrive to brooke it again.

Now, as concerning thoſe Animals who lay up in ſtore for winter, & ſeem therein to excerciſe a rationall providence; who ſeeth not, that it is the ſame humour, which moveth rich miſers to heap up wealth, even at their laſt gaſp, when they have no child nor friend to give it to, nor think of making any body their heires? Which actions becauſe they have no reaſon in them, are to be imputed to the paſſion or motion of the materiall appetite. In the doing of them, theſe ſteppes may be obſerued; firſt the obje& preſenting it ſelf to the Eye provoketh love and deſire of it; eſpecially if it be joyned with the memory of former want: then, this deſire ſtirreth up the animal (after he hath fed himſelf) together into the place of his chief reſidence, as much of that deſired obje& as he meeteth withall; and whenſoever, his hunger returning, bringeth back into his fantaſy the memory of his meat, it being joyned with the memory of that place (if he be abſent from it) he preſently repaireth thither, for relief of what preſſeth him: (and thus Dogs when they are hungry, do rake for bones they had hidden when their bellies were full.) Now if this food, gathered by ſuch providence (which is nothing elſe, but the conformity of it working upon him by his ſence) and layed up in the place where the owner of it reſideth, (as the corne is which the Ants gather in ſummer) be eaſily portable, he will carry it abroad with him the firſt time he ſtirreth after a long keeping in; for then nothing worketh ſo powerfully in his fantaſy, as his ſtore; and he will not eaſily part from it, though other circumſtances invite him abroad. From hence it proceedeth, that when a faire day commeth after long foule weather, the Ants, who all that while kept cloſe in their dennes with their corne lying by them, do then come abroad in the Sun, and do carry their graine along with them: or peradventure it happeneth, becauſe the precedent wet weather, hath made it grow hot, or muſty, or other-

9 Concerning the providence of Ants in laying up in ſtore for winter.

wiſe offenſive within; and therefore they carry it out, as ſoon as themſelves dare peep abroad; which is, when the faire weather and heat of the day, inviteth them out into the open ayr: and before night that they return into their holes, the offenſive vapors of the corne are exhaled and dryed up, and move their fantaſies no longer to averſion, whereupon they carry it back again; having then nothing but their long contracted love unto it to work upon them. The like whereof men doing by diſcourſe, to ayr their corne, and to keep it ſweet, and the ſame effect following herein, they will preſently have it, tht this is done by the Ants, for the ſame reaſon, and by deſigne. Then the moyſture of the earth ſwelling the graine, and conſequently, making it begin to ſhoot at the ends (as we declared, when we ſpoke of the generation of plants, and as we ſee in the moyſtening of corne to make malt of it) thoſe little creatures, finding that part of it more tender and juycy then the reſt, do nibble upon it there, and do feed themſelves firſt with that, which conſequently hindereth the growth of the corne. And here again, men will contend that this muſt be done by providence and diſcourſe, to prevent that their ſtore ſhould not grow out of their reach, and changing nature, become uſeleſſe to them in their need.

10 Concerning the foreknowing of Beaſts.

To conclude, the foreknowing of beaſts is nothing elſe, but their timely receiving impreſſions, from the firſt degrees of mutation in things without them; which degrees are almoſt imperceptible to us, becauſe our fantaſies & ſpirits, have otherwiſe ſuch violent agitations, more then theirs, which hinder them from diſcerning gentle impreſſions upon them. If you be at Sea, after a long calme, a while before a gale bloweth to fill your ſailes, or to be diſcernable by your ſenſe in quality of wind, you ſhal perceive the Sea begin to wrinkle his ſmooth face that way the wind will come; which is ſo infallible a ſigne that a gale will come from that coaſt, as mariners immediately, fall to trimming their ſailes accordingly; and uſually, before they can have done, the wind is with them: ſhall we therefore ſay that the Sea hath a providence to foreſee which way the wind will blow? Or that the cornes upon our toes, or calluſes, or broken bones or joynts that have been diſlocated, have diſcourſe, & can fore-

tell,

tell the weather? It is nothing elſe, but that the wind riſing by degrees, the ſmooth Sea is capable of a change by it, before we can feele it: and that the Ayr, being changed by the forerunners of worſe weather, worketh upon the crafieſt parts of our body, when the others feele not ſo ſmal a change: ſo beaſts are more ſenſible then we (for they have leſſe to diſtract them) of the firſt degrees of a changing weather: and that mutation of the Ayr without them, maketh ſome change within them, which they expreſſe, by ſome outward actions or geſtures.

Now they who obſerve, how ſuch mutations and actions are conſtantly in them before ſuch or ſuch weather, do think they know beforehand, that rain (for example) or wind, or drought is comming, according to the ſeveral ſignes they have marked in them: which proceedeth out of the narrowneſs of their diſcourſe, that maketh them reſort to the ſame cauſes, whenſoever they meet with like effects: & ſo they conceive, that things muſt needs paſſe in beaſts, after the ſame tenour, as they do in men. And this is a generall, and main errour, running through all the conceptions of mankind, unleſſe great heed be taken to prevent it, that what ſubiect ſoever they ſpeculate upon, whether it be of ſubſtances, that have a ſuperiour nature to theirs, or whether it be of creatures inferiour to them, they are ſtil apt to bring them to their own ſtandard, and to frame ſuch conceptions of them, as they would do of themſelves: as when they will have Angels diſcourſe, and move and be in a place, in ſuch ſort as is naturall to men; or when they will have beaſts rationate and underſtand, upon their obſerving ſome orderly actions performed by them, which in men would proceed from diſcourſe and reaſon. And this dangerous Rock (againſt which many fine conceptions do ſuffer ſhipwrack) whoſoever ſtudieth truth muſt have a main caution to avoyd.

Sed nos immenſum ſpatiis confecimus æquor:
Et jam tempus equum fumantia ſolvere colla.

THE CONCLUSION OF THE *FIRST TREATISE.*

THus at the laſt (by Gods aſſiſtance) we have climbed up to the top of the hill; from whence looking down over the whole region of bodies, we may delight our ſelves, with ſeeing what a height the weary ſteps we aſcended by, have brought us unto. It is true, the path we have walked in, is of late ſo untrodden, and ſo overgrown with bryars, as it hath not been without much labour, that we have made our way through. And peradventure, it may ſeem toyleſome unto others to follow us, eſpecially ſuch as are not much enured to like journeys: but I hope, the fruit which both we and they are now arrived together of our paines, in this generall view we have taken of the empire of matter, and of corporeal agents, is ſuch, as none of us hath reaſon to be ill ſatisfied with the imploying of them. For what can more powerfully delight, or more nobly entertaine an underſtanding ſoul, then the ſearch and diſcovery of thoſe works of nature, which being in their effects ſo plainly expoſed to our eyes, are in their cauſes ſo abſtruſe and hidden from our comprehenſion, as (through diſpaire of ſucceſſe) they deter moſt men from enquiring into them?

And

And I am perſwaded, that by this ſummary diſcourſe (ſhort indeed, in regard of ſo large a ſcope, how ever my lame expreſſions may peradventure make it appeare tedious) it appeareth evidently, that none of natures greateſt ſecrets, whereof our ſenſes give us notice in the effects, are ſo over ſhaded with an impenetrable veile, but that the diligent & wary hand of reaſon might unmaske them and ſhew them to us, in their naked and genuine formes, and delight us with the contemplation of their native beauties; if we had as much care and conſtancy in the purſuit of them, as we daily ſee men have in heaping up of wealth, or in ſtriving to ſatisfie their boundleſſe ambitions; or in making their ſenſes ſwim in the muddy lake of baſe and contemptible pleaſures. For who ſhall throughly conſider and weigh what we have hitherto ſaid, will plainly ſee a continuall and orderly progreſſe, from the ſimpleſt, higheſt, and moſt common conception, that we frame of a body in generall, unto the furtheſt and moſt abſtruſe effects, that in particulars are to be found in any body whatſoever: I mean, any that is meerely corporeal, without mixture of a nobler nature; for hitherto we have not moved, nor ſo much as looked out of that Orbe: He ſhall finde one continued thread, ſpunne out from the begining to the end. He will ſee, that the various twiſting of the two ſpecieſes of *Bodies*, *rare*, and *Denſe*, do make the yarne, of which all things and actions with the ſphere of matter are woven.

And although peradventure, in the drawing out of the thread, there may be ſome little brackes, or the ſtuffe made of it be not every where ſo cloſe wrought, as a better workman at more leiſure might have done; yet truely, I believe, that the very conſent of things throughout is ſuch, as demonſtrateth, that the maine contexture of the doctrine I have here touched, is beyond quarrelling at. It may well be that in ſundry particulars, I have not lighted upon exact truth: and I am ſo farre from maintaining peremptorily any thing I have here ſaid, as I ſhall moſt readily hearken to whatſoever ſhall be objected againſt it; and be as ready upon cauſe, to deſert my own opinions, and to yeeld unto better reaſon. But withall, I conceive,

ceive, that as the failing of a brick here and their in the rearing of the walls of a house, doth nothing at all prejudice the strength and security of the fabricke; no more (I hope) will the slight escapes, which so difficult a taske as this is subject unto, endamage or weaken the main body of what I have here delivered. I have not yet seen any piece upon this subject made up with this method, beginning from the simplest and plainest notions, and composing them orderly, till all the principall variety which their nature is capable of, be gone through: and therefore it cannot be expected, but that the first modell of this kind (and moulded by one distracted with continuall thoughts of a much different straine; and whose exercise, as well as profession, hath allowed him but little commerce with bookes and study) must needs be very rough hewed, and require a great deale of polishing. Which whosoever shall do, and be as exact and orderly in treating of Philosophy and Theology, as Mathematicians are in delivering their sciencies, I do assure my self, that *Demonstrations* might be made, and would proceed in them as currantly, and the conclusions be as certaine and as full, as in the Mathematicks themselves. But that is not all: these demonstrations would have the oddes exceedingly of the other, and be to us inestimably more advantagious: for out of them, do spring much higher and nobler effects, for mans use and life, then out of any Mathematicall ones; especially when they extend themselves to the government of *Man* as he is *Man*: which is an art, as farre, beyond all the rules of Physick, or other government of our body, or temporall goods, as the end is beyond the meanes, we employ to gain it; for all the others, do but serve instrumentally to this end, *That we may live well*: whereas these do immediately teach it.

These are the fruits in generall, that I hope may in some measure, grow out of this discourse, in the hands of equal and judicious Readers: but the particular ayme of it, is to shew what actions can proceed from a body, and what cannot. In the conduct whereof, one of our chief endeavours hath been to shew, that those actions which seem to draw strongly in-

to

to the order of bodies, the unknown nature of certaine Entities named *Qualities*; either do or may proceed, from the ſame cauſes, which produce thoſe known effects, that, all ſides agree, do not ſtand in need of any ſuch miſticall Philoſophy. And this being the main hinge, upon which hangeth & moveth the full and clear reſolving of our main, and great queſtion, *Of the immortality of the ſoule*; I aſſure my ſelf, the paines I have taken in this particular, will not be deemed ſuperfluous or tedious: and withall, I hope I have employed them with ſo good ſucceſſe, as henceforward, we ſhall not be any more troubled, with objections drawn from their hidden and incomprehenſible nature: and that we ſtand upon even ground, with thoſe of the contrary opinion: for ſince we have ſhewed, how all actions may be performed among bodies, with out having any recourſe to ſuch *Entities* & *Qualities* as they pretend and paint out to us, it is now their part (if they will have them admitted) to prove that in nature there are ſuch.

Having then brought the Philoſophy of bodies unto theſe termes; that which remaineth for us to performe, is to ſhew that thoſe actions of our ſoul, for which we call her a ſpirit, are of ſuch a nature, as they cannot be reduced into thoſe principles, by which all corporeal actions are effected. For the proof of our original intent, no more then this, can be exacted at our hands; ſo that if our poſitive proofes, ſhall carry us yet beyond this, it cannot be denyed, but that we give over meaſure, and do illuſtrate with a greater light, what is already ſufficiently diſcerned. In our proceeding, we have the precedency of nature; for laying for our ground the naturall conceptions which mankind maketh of quantity; we finde that a body is a meere paſſive thing, conſiſting of divers parts which by motion may be diverſly ordered; and conſequently that it is capable of no other change or operation, then ſuch as motion may produce, by various ordering the divers parts of it: and then, ſeeing that *Rare* and *Denſe*, is the primary and adequate diviſion of *Bodies*; it followeth evidently that what cannot be effected by the various diſpoſition of rare and denſe parts; cannot proceed or be effected by a pure body

body: and consequently, it will be sufficient for us to shew, that the motions of our soules are such: and they who will not agree to this conclusion, must take upon them to shew, that our first premisse is defective; by proving that other unknown waies are necessary, for bodies to be wrought upon, or to work by: and that the motion, and various ordering of rare and dense parts in them, is not cause sufficient for the effects we see among them. Which whosoever shall attempt to do, must remember that he hath this disadvantage before he beginneth, that whatsoever hath been hitherto discovered in the science of bodies, by the help either of Mathematicks or Physicks, it hath all been resolved, & hath fallen into this way which we declare.

Here I should set a period to all further discourse concerning this first Treatise of bodies, did I not apprehend, that the prejudice of Aristotles authority, may dispose many to a harsh conceit of the draught we have made. But if they knew how little reason they have to urge that against us, they would not cry us down for contradicting that Oracle of nature: not onely because he himself, both by word, and by example, exhorteth us, when verity leadeth us another way, to forsake the tricks which our forefathers have beaten for us, so we do it with due respect and gratitude for the much they have left us: nor yet because Christian Religion, as it will not heare of any man (purely a man) free from sin, so it inclineth to perswade us, that no man can be exempt from errour; and therefore it savoureth not well, to defend peremptorily any mans sayings (especially if they be many) as being uncontrollable; howbeit I intend not to prejudice any person, that to defend a worthy Authors honour, shall endeavour to vindicate him from absurdities & grosse errours: nor lastly, because it hath ever been the common practise of all grave Peripateticks & Thomists, to leave their Masters, some in one article, some in another: but indeed, because the very truth is, that the way we take, is directly the same solid way, which Aristotle walked in before us: and they who are scandalised at us for leaving him, are exceedingly mistaken in the matter: and out of the

the ſound of his words (not rightly underſtood) do frame wrong ſenſe of the doctrine he hath left us which generally we follow.

Let any unpartiall Ariſtotelian anſwer, whether the conceptions we have delivered of *Quantity*, of *Rarity* and *Denſity*, of the *foure firſt Qualities*, of the *combinations* of the *Elements*, of the *repugnance of vacuities*, be not exactly and rigorouſly Ariſtotles? Whether the motion of weighty and light things, and of ſuch as are forced, be not by him, as well as by us, attributed to externe cauſes? In which all the difference between us is, that we enlarge our ſelves to more particulars then he hath done. Let any man read his bookes of Generation and Corruption, and ſay whether he doth not expreſſely teach, that mixtion (which he delivereth to be the generation or making of a mixt body) is done *per minima*; that is in our language and in one word, by atomes; and ſignifyeth, that all the qualities, which are naturall qualities following the compoſition of the Elements, are made by the mingling of the leaſt parts or atomes of the ſaid Elements; which is in effect to ſay; that all the nature of bodies, their qualities, and their operations, are compaſſed by the mingling of atomes: the ſhewing and explicating of which, hath been our labour in this whole Treatiſe. Let him read his bookes of Meteors, and judge whether he doth not give the cauſes of all the effects he treateth of there, by mingling and ſeparating of great and little, groſſe and ſubtile, fiery and watery, ayery and earthy parts, juſt as we do. The ſame he doth in his *Problems*, and in his *Parva naturalia*, and in all other places, whereſoever he hath occaſion to render Phyſically, the cauſes of Phyſicall effects. The ſame do Hippocrates and Galen: the ſame, their Maſter Democritus; and with them the beſt ſort of Phyſitians: the ſame doe Alchymiſtes, with their maſter Geber; whoſe maxime to this purpoſe, we cited above: the ſame do all naturall Philoſophers, either ancient commentatours of Ariſtotle, or elſe moderne enquirers into naturall effects, in a ſenſible and underſtandable way: as who will take the paines to look into them, will eaſily perceive. Wherefore, let any judicious Reader that hath looked further into Ariſtotle then onely upon

upon his Logicall and Metaphyſicall workes, judge whether in *bulke* our Doctrine be not conformable to the courſe of his, and of all the beſt Philoſophers that have been and are; though in *detaile* or particulars, we ſometimes mingle therewith, our own private judgements as every one of them, hath likewiſe ſhewed us the way to do, by the liberty themſelves have taken to diſſent in ſome points from their predeceſſours.

And were it our turne, to declare and teach Logick and Metaphiſickes, we ſhould be forced to go the way of *matter*, and of *formes*, and of *privations*, in ſuch ſort as Ariſtotle hath trodden it out to us, in his workes of that ſtraine. But this is not oure taske for the preſent; for no man that contemplateth nature as he ought, cannot chooſe but ſee that theſe notions are no more neceſſary, when we conſider the framing of the elements, then when we examin the making of compounded bodies: and therefore, theſe are to be ſet a part as higher principles, and of another ſtraine, then need be made uſe of for the actuall compoſition of compounded things, and for the reſolution of them in their materiall ingredients, or to cauſe their particular motions; which are, the ſubjects we now diſcourſe of.

Upon this occaſion, I think it not amiſſe to touch, how the latter ſectatours, or rather pretenders of Ariſtotle, (for truly they have not his way) have introduced a modell of doctrine (or rather of ignorance) out of his words, which he never ſo much as dreamed of; howbeit they alledge texts out of him to confirme what they ſay, as Heretickes do out of Scripture to prove their aſſertions: for whereas he called certaine collections or poſitions of things, by certaine common names (as the art of Logick requireth) terming ſome of them *Qualities*, others *Actions*, others *Places*, or *Habites*, or *Relatives*, or the like: theſe his latter followers, have conceited that theſe names did not deſigne a concurrence of ſundry things, or a divers diſpoſition of the parts of any thing, out of which ſome effect reſulted; which the underſtanding conſidering all together, hath expreſſed the notion of it by one name

name: but have imagined, that every one of these names had correspondent unto it some reall positive entity or thing, seperated (in its own nature) from the main thing or substance in which it was, and indifferent to any other substance; but in all unto which it is linked, working still that effect, which is to be expected from the nature of such a *quality*, or *action*, &c. And thus, to the very negatives of things, as to the names of points, lines, instants, and the like, they have imagined positive Entities to correspond: likewise, to the names of *actions*, *places*, and the like, they have framed other Entities: as also to the names of *colours*, *sounds*, *tasts*, *smells*, *touches*, and the rest of the *sensible qualities*, they have unto every one of them, allotted speciall Entities, and generally to all qualities whatsoever. Whereas nothing is more evident, then that Aristotle meaned by *qualities* no other thing, but that disposition of parts, which is proper to one body, and is not found in all: as you will plainly see, if you but examin, what *beauty*, *health*, *agility*, *science*, and such other qualities are; (for by that name he calleth them; and by such examples giveth us to understand what he meaneth by the word *Quality*) the first of which is nothing else but a composition of severall parts and colours, in due proportion to one another: the next, but a due temper of the humours, and the being of every part of the body, in the state it should be: the third, but a due proportion of the spirits and strength of the sinewes: and the last, but ordered Phantasmes.

Now when these perverters of Aristotle have framed such Entities, under that conception which nature hath attributed to substances, they do immediately upon the nick, with the same breath that described them as substances, deny them to be substances: and thus they confound the first apprehensions of nature, by seeking learned and strained definitions for plain things. After which they are faine to look for glew and paste to joyn these Entities unto the substance they accompany: which they finde with the same facility, by imagining a new Entity, whose nature it is to do that which they have need of.

And

And this is the generall course of their Philosophy; whose great subtilty, and queint speculations in enquiring how things do come to passe afford no better satisfaction then to say upon every occasion, that there is an *Entity* which maketh it be so. As if you aske them, how a *wall is white or black?* They will tell you, there is an *Entity* or *Quality*, whose essence is to be *whitenesse or blacknesse*, diffused through the wall. If you continue to aske, how doth whiteneſſe stick to the wall? They reply, that it is by means of an Entity called *Union*, whose nature it is actually to joyne whiteneſſe, and the wall together. And then if you enquire how it commeth to passe, that one white is like another? They will readily answer, that this is wrought by another Entity, whose nature is to be *likenesse*, and it maketh one thing like another. The consideration of which doctrine, maketh me remember a ridiculous tale of a trewant schoolboyes latine: who upon a time when he came home to see his friends, being asked by his father, what was latine for *bread?* answered *bredibus*; and for *beere? beeribus*; and the like of all other things he asked him, adding onely a termination in *bus*, to the plaine English word of every one of them: which his father perceiving, and (though ignorant of Latine) yet presently apprehending, that the mysteries his sonne had learned, deserved not the expence of keeping him at schoole, bad him immediately put off his *hosibus* and *shoosibus*, and fall to his old trade of treading *Morteribus*. In like manner, these great Clarks do as readily find a pretty Quality or mood, whereby to render the nature or causes of any effect in their easie Philosophy, as this Boy did a *Bus* to stamp upon any English word, and coyn it into his mock latine.

But to be serious, as the weight of the matter requireth, let these so peremptory pretenders of Aristotle, shew me but one text in him, where he admitteth any middle distinction (such as those modern Philosophers do, and must needs admit, who maintaine the qualities we have rejected) betwixt that which he calleth *Numericall*, and that which he calleth of *Reason*, or of *Notion*, or of *Definition*, (the first of which we may terme to be of or *in things*; the other to be *in our heads*, or *discourses*: or the one

One *Natural*, the other *Logical:*) and I will yield that they have reaſon, and that I have groſſely miſtaken what he hath written, and that I do not reach the depth of his ſenſe. But this they will never be able to do.

Beſides, the whole ſcope of his doctrine, and all his diſcourſes and intentions, are carried throughout, and are built upon the ſame foundations, that we have laid for ours. Which being ſo, no body can quarrel with us for *Ariſtotles* ſake; who as he was the greateſt Logician, and Metaphyſician, and univerſal Scholar peradventure that ever lived; and was ſo highly eſteemed, that the good turn which *Sylla* did the world in ſaving his works, was thought to recompence his many outragious cruelties and tyranny; ſo his name muſt never be mentioned among Scholars, but with reverence, for ſo unparalleled worth; and with gratitude, for the large ſtock of knowledge he hath enriched us with. Yet withall we are to conſider, that ſince his reign was but at the beginning of ſciences, he could not chooſe but have ſome defects and ſhortneſſes, among his many great and admirable perfections.

THE SECOND

TREATISE:

DECLARING,

THE NATURE AND OPERATIONS OF MANS SOUL;

OUT OF WHICH,

THE IMMORTALITY OF REASONABLE SOULS, IS CONVINCED.

Pro captu Lectoris, habent sua fata libelli.

LONDON,
Printed in the year 1657.

THE SECOND

TRIAL ISF

REFORMATION

THE NATURE

OF

ORIGINATION

OF

MASSOULL

OUT OF WHICH

THE IMMORTALITY

OF

REASONABLE SOULS

IS CONVINCED.

In Opposition to Dr. Henry More's Second Book.

LONDON:

Printed in the Year 1677.

THE PREFACE.

IT is now high time for us to caſt an eye upon the other leaf of our accounts: or peradventure I may more properly ſay, to fall to the peruſal of our own accounts: for hitherto, our time and pains have been taken up, in examining and caſting the accounts of others: to the end, that from the foot and total of them, we may drive on our own the more ſmoothly. In ours then, we ſhall meet with a new Capital; we ſhall diſcover a new World, of a quite different ſtrain and nature from that which all this while we have imployed our ſelves about. We will enter into them, with taking a ſurvey of the great Maſter of all that large family, we have ſo ſummarily viewed: I mean of Man, *as he is* Man: *that*

is, not as he is subject to those laws, whereby other bodies are governed (for therein he hath no preeminence, to raise him out of their throng:) but as he exceedeth the rest of creatures, which are subject to his managing; and as he ruleth over nature herself, making her serve his designs; and subjecting her noblest powers to his laws; and as he is distinguished from all other creatures whatsoever. To the end we may discover, whether that principle in him, from whence those actions do proceed which are properly his, be but some refined composition, of the same kind we have already treated of: or whether it deriveth its source and origine from some higher spring and stock, and be of a quite different nature.

Having then by our former Treatise mastered the oppositions, which else would have taken arms against us, when we should have been in the middest of our edifice; and having cleared the objections which lay in our way, from the perverse Qualities of the soul's neighbours, the several common-wealths of Bodies: we must now bring with David to gather together our Materials, and to take a survey of our own provisions: that so we may proceed with Salomon, to the sacred building of Gods Temple. But before we go about it, it will not be amiss, that we shew the reason, why we have made our porch so great, and have added so long an entry, that the house is not likely to have thereunto a correspondent bulk: and when the necessity of my doing so, shall appear, I hope my pains will meet with a favorable censure, and receive a fair admittance.

We proposed unto our selves to shew that our souls are Immortal: *whereupon, casting about to find the grounds of* immortality, *and discerning it to be a negative, we conceived that we ought to begin our search, with enquiring* what mortality is; *and what be the causes of it. Which*

when

when we should have discovered, and have brought the soul to their test, if we found they trenched not upon her, nor any way concerned her condition, we might safely conclude, that of necessity she must be immortal. Looking then into the causes of mortality, we saw that all bodies round about us were mortal: whence perceiving that mortality extended it self as far as corporeity; we found our selves obliged, if we would free the soul from the law, to shew that she is not corporeal. This could not be done without enquiring what corporeity was. Now it being a rule among Logicians, that a definition cannot be good, unless it comprehend and reach to every particular of that which is defined; we perceived it impossible to know compleatly, what a Body is, *without taking a general view of all those things which we comprise under the name and meaning of* Bodies. *This is the cause we spent so much time in the first Treatise: and I hope to good purpose; for there we found that the nature of a Body consisted in being made of parts: that all the differencie of bodies are reduced to having more or less parts, in comparison to their substance, thus and thus ordered: and lastly, that all their operations, are nothing else but local motion, which followeth naturally out of having parts. So as it appeareth evidently from hence, that if any thing have a being, and yet have no parts, it is not a body, but a substance of another quality and condition: and consequently, if we can find the souls Being to be without parts, and that her operations are no local translation; we evidently conclude her to be an immaterial or spiritual substance.*

Peradventure it may be objected, that all this might have been done a much shorter way than we have taken; and that we needed not have branched our discourse, into so many particulars, nor have driven them so home, as we have done: but that we might have taken our first rise from this ground,

(*which*

(*which is as evident, as light of reason can make it*) *that seeing we know* Bignets *and a* Body, *to be one and the same, as well in the notion as in the thing; it must of necessity follow, that what hath not parts, nor worketh, nor is wrought upon by division,* is not a body. *I confess, this objection appeareth very reasonable, and the consideration of it weighed so much with me, as, were all men of a free judgement, and not imbued with artificial errours, I would for its sake, have saved my self a great deal of pains: but I find (as in the former Treatise I have frequently complayned of) that there is crept into the world a fansie so contrary to this pregnant truth, and that it is so deeply setled in many mens minds (and not of the meaneſt note) as all we have said is peradventure too little to root it out.*

If any that being satisfied with the rational maxim we even now mentioned, and therfore hath not deemed it needfull to imploy his time in reading the former Treatise, should wish to know how this is come to pass, I shall here represent unto him, the sum of what I have more at large scattered in several places of the former Treatise; and shall intreat him to consider, how nature teacheth us to call the proprieties of things whereby one is distinguished from another, the Qualities *of those things; and that according to the varieties of them, they have divers names suited out to divers of them; some being called* Habits, *others* Powers, *and others by other names. Now what* Aristotle, *and the learned Grecians did mean by these things is cleer by the examples they give of them: they term* Beauty *and* Health, Habits, *the dispositions of our bodies to our bodily motion;* Powers; *as* strength (*which is the good temper of the sinews*) a Power; *likewise* Agility a Power; *so they use the names of the concoctive, the nutritive, the retentive, the excretive,* Power; *the health of the eyes, the ears, the nostrils, &c. they*

they call the Powers of Seeing, of Hearing, of Smelling, &c. and the like of many others. But latter philosophers being very disputative, and desiring to seem ignorant of nothing (or rather, to seem to know more than any that are gone before them, and to refine their conceptions) have taken the notions, which by our first Masters were set for common and confused explications of the natures, (to serve for conveniency and succinctness of discourse) to be truly and really particular Entities, or things of themselves: and so have filled their Books, and the Schools, with unexplicable opinions, out of which no account of nature can be given: and which is worse, the way of searching on, is barred to others; and a mischievous error is grown into mens beliefs, that nothing can be known. By this means they have choaked the most plain and evident definition of a Body; bringing so many instances against it, that unwary men are forced to desert and deny the very first notions of nature and reason: for in truth, they turn all bodies into spirits, making (for example) heat, or cold, to be of it self indivisible, a thing by it self, whose nature is not conceivable; not the disposition or proportion of the parts of that body which is said to be hot or cold; but a real thing, that hath a proper Being and nature peculiar to it self; whereof they can render you no account, and so may as well be against the notion of a body as not: for if light, the vertue of the loadstone, the power of seeing, feeling, &c. be things that work without time, in an instant; if they be not the dispositions of parts as parts, (whose nature is, to be more or less, to be next or far off, &c.) how can it be truely said, that the notion of a body, is to be of parts? For if this be a true definition of a body, it followeth that all corporeal qualities and actions must likewise be some disposition and order of parts as parts: and that what is not so, is no body, nor bodily quality or propriety.

This then was it that obliged me to go ſo far about, and to ſhew in common, how all thoſe effects which are ſo much admired in bodies, are, or may be made and continued by the ſole order of quantitative parts and local motion: this hath forced us to anatomize nature, and to begin our diſſection, with what firſt occurreth our ſenſe from a body. In doing which, out of the firſt and moſt ſimple notion of Bigneſs *or* Quantity, *we found out the prime diviſion of* Bodies, *into* rare *and* Denſe: *then finding them to be the qualities of* dividing *and of being* divided (*that is of* local motion) *we gained knowledge of the common properties of* Gravity *and* Levity: *from the combination of theſe, we retrived the* four firſt Qualitie: *and by them,* the Elements. *When we had agreed how the elements were made, we examined how their action & compoſition raiſeth thoſe* ſecond qualities, *which are ſeen in all mixt bodies, and do make their diviſions. Thence, proceeding into* the operations of life, *we reſolved, they are compoſed & ordered meerly by the varieties of the former: nay, that* ſenſe *and* fantaſy (*the higheſt things we can diſcern out of man*) *have no other ſource, but are ſubject to the Lawes of parts and of Rarity and Denſity; ſo that in the end we became aſſured of this important Maxime: That* nothing whatſoever we know to be a Body, can be exempted from the declared Laws, and orderly motions of Bodies; *unto which, let us add two other poſitions, which fall alſo within our diſcovery: the firſt that it is conſtantly founded in nature,* that none of the bodies we know, do move themſelves; but their motion muſt be founded in ſome thing without them: the ſecond, that no body moveth an other, unleſs it ſelf be alſo moved & *it will follow evidently out of them (if they be of neceſſity & not prevaricable) that ſome other Principle beyond*

beyond bodies, is required to be the root and first ground of motion in them: as Mr. White *hath most accutely and solidly demonstrated, in that excellent work I have so often cited in my former Treatise.*

But it is time we should fall to our intended discourse, leaving this point settled by what we have already said, that if we shew our soul, and her operations, to be not composed of parts, we also therein conclude, that she is a spiritual substance, and not a body. Which is our design and intention in this Treatise. Dialog. 3^a. Nudo 2do.

And for this intent, we must look upon those actions of men, which are peculiarly his: and upon those things which result out of them, and are called, Opera, *or* labores hominum; *as Houses, Towns, Tillage Handicrafts, Armes, Ships common-wealths, Armies, Books, and the like; in which great mens lifes and thoughts have been spent. In all these we find one general thred, to run quite through them; & that all of them are composed of the same stuff, & are built upon the same foundation: which is, a long chain of discourses, whereof every little part or link is that which Schollers do call a* Syllogisme: *and* Syllogismes *we know are framed of* enuntiations; *and they of single or uncomposed* apprehensions. *All which are actions wrought by the understanding of a man. But beyond these, we cannot proceed to any farther subdivision of parts, and continue our selves within the Orbe* of human Actions; *for simple apprehensions cannot be farther resolved into other parts, beyond the degree of apprehensions, and yet still remain actions peculiar to a man so that we may be sure, we shall have left nothing out of enquiry, concerning* Mans actions *as he is* Man, *if we begin with anatomizing his first bare apprehensions; and so go on by degrees, compounding them, till we come to faddom those great and admirable machines of books and works, which*

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he (as I may ſay) weaveth out of his own bowels; & the like which, is don by no other creature whatſoever, upon the face of our contemptible Earth.

Theſe then (which are all compriſed under the names of Apprehenſions, *of* Enuntiations *or* Judgements, *and of* Diſcourſes) *ſhall be the ſubject of this ſecond Treatiſe: and in it we will firſt conſider theſe operations in themſelves; which being done, we will endeavour to prove out of the nature and manner of performing them, that the ſouls unto whom they belong, are* Immaterial *and* Immortal.

THE

THE SECOND TREATISE:

DECLARING

The nature and operations of Mans Soul.

THE FIRST CHAPTER.

Of simple Apprehensions.

THat we may duly understand, what a right Apprehension is, let us consider the preeminence that a man who apprehendeth a thing rightly, hath over him who misseth of doing so. This latter can but rove wildly at the nature of the thing he apprehendeth; and will never be able to draw any operation into act, out of the apprehension he hath framed of it. As for example: if a man be to work upon gold, and by reason of its resemblance unto brasse, hath formed an apprehension of brasse, instead of an apprehension of gold, and then (knowing that the action of fire, will resolve brasse into its least parts, and sever its moist from its dry ones) will go about to calcine gold in the same manner as he would do brasse; he will soon finde that he loseth his labour; and that ordinary fire is not an adequate Agent to destroy the homogeneral nature, and to sever the minute parts of that fixed mettal: all which happeneth, out of the wrong apprehension he hath made of gold. Whereas on the other side, he that apprehendeth a thing rightly, if he pleaseth to discourse of what he apprehendeth, findeth in his apprehension all the parts and qualities, which are in the thing he discourseth of: for example, if he apprehendeth rightly a knife, or a beetle, or a vice, or any other thing whatsoever; in the *knife* he will finde *haft* and *blade*; the blade of iron, thick on the back, and thin on the edge; tempered to be hard and tough; thus beaten, so ground, in such manner softned, thus quenched, and whatsoever else concer-

1. What is a right apprehension of a thing

neth the *being* or the making of a knife: and all this he draweth out of his notion or apprehenſion of a knife; which is, *that it is an inſtrument fitted to cut ſuch and ſuch things, in ſuch a manner:* for hence he findeth, that it hath an haft, fit to hold it by in ones hand, to the end it may not hurt the hand, whiles it preſſeth upon the knife; and that the blade is apt to ſlide in betwixt the parts of the thing which is to be cut, by the motion of being preſſed or drawn by the hand: and ſo he proceedeth on, deſcending to the qualities of both parts; and how they are to be joyned, and held faſt together. In the like manner, he diſcourſeth of a beetle, of a five, or of whatſoever elſe cometh in his way. And he doth this, not onely in ſuch manufactures as are of mans invention; but (if he be capable) he doth the like in beaſts, in birds, in trees, in herbs, in fiſhes, in foſſiles, and in what creature ſoever he meeteth withal, within the whole extent of nature. He findeth what they are made for: and having diſcovered Natures end in their production, he can inſtruct others, what parts and manner of generation they have, or ought to have: and if he that in this manner apprehendeth any thing rightly, hath a minde to work upon it, either to make it, or to uſe and order it to ſome end of his own; he is able by his right apprehenſion, to compare it unto other things; to prepare what is any way fitting for the making of it; to apply it unto what it will work its effect upon; and to conſerve it from what may wrong or deſtroy it: ſo, if he have framed a right apprehenſion of a five, he will not employ it in drawing water; if of a beetle, he will not go about to cut with it; neither will he offer, if he have a due apprehenſion of a knife, to cut ſtone or ſteel with it, but wood, or what is ſofter. He knoweth what will whet and maintain the edge of it; and underſtandeth what will blunt or break it: In fine, he uſeth it in ſuch ſort, as the knife it ſelf (had it knowledge and will) would wiſh to be uſed; and moveth it in ſuch a manner, as if it had power of motion, it would move it ſelf: he goeth about the making it, even as nature would do, were it one of her plants: and in a word, the knife in this apprehenſion made in the man, hath thoſe cauſes, proprieties, and effects, which are natural unto it; and which nature would give it, if it were made by her; and which are proportionable to thoſe parts, cauſes, proprieties and effects, that nature beſtoweth on her children and creatures, according to their ſeveral eſſences.

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What then can we imagine, but that the very nature of a thing apprehended, is truly in the man, who doth apprehend it? And that to apprehend ought, is to have the nature of that thing within ones self? And that man, by apprehending, doth become the thing apprehended; not by change of his nature unto it, but by assumption of it unto his?

2. The very thing it self is truly in his understanding who rightly apprehendeth it.

Here peradventure some will reply, that we press our inference too far: and will peremptorily deny the things real being in our mind, when we make a true and full apprehension of it; accounting it sufficient for our purpose, that some likeness, or image of the thing be there; out of which, we may draw all these, whether contemplations, or works, or disposals of the thing. But by that time this objection is throughly looked into, and that so much as they allow is duly examined, I believe we shall finde our quarrel to be onely about the word, not about the matter: and that indeed, both of us do mean the same, howbeit diversly conceived: and that in substance their expression, in what they grant, importeth the same as ours doth: which, it is true, they first deny in words; but that may be, because the thing is not by them rightly understood.

Let us then discuss the matter particularly. What is likeness, but an imperfect unity between a thing, and that which it is said to be like unto? If the likeness be imperfect, it is more unlike than it is like unto it: and the liker it is, the more it is one with it; until at length, the growing likeness may arrive to such a perfection, and to such an unity with the thing it is like unto, that then, it shall no longer be like, but is become wholly the same, with that formerly it had but a resemblance of. For example, let us consider, in what consisteth the likeness unto a man, of a picture drawn in black and white representing a man: and we shall find, it is onely in the proportion of the limbs and features; for the colours, the bulk, and all things else are unlike; but the proportions are the very same, in a man and in a picture; yet that picture is but a likeness, because it wanteth bigness and colour: give it them, and nevertheless it will be but a likeness, because it wanteth all the dimensions of corporeity or bulk, which are in a mans body: add also those to it; and still it will be but a likeness or representation of a man, because it wanteth the warmth, the softness, and the other qualities

of a living body, which belong to a man: but if you give all theſe, then it is no longer a likeneſs or image of a living creature, but a living creature indeed; and if peradventure this living creature do continue ſtill to be but the likeneſs of a man, it is becauſe it wanteth ſome perfections or proprieties belonging to a man: and ſo in that regard, is unlike a man: but if you allow it all thoſe, ſo that in nothing it be unlike, then your taking away all unlikeneſs, taketh away likeneſs too: and as before of dead, it became a living creature, ſo now of another living creature, it becometh a man, and is no longer like a man. You ſee then plainly the reaſon, why that, which we call *a like thing*, is not *the ſame*; for in ſome part it is diſſlike: but if the likeneſs were compleat in every regard, then it were no longer to be called *like*, but the very thing it ſelf: and therefore we may conclude, that if the likeneſs of a thing, which the objection alloweth to be in our knowledge, do contain all that is in the thing known, then it is in truth, no more a likeneſs, but the very known thing it ſelf: and ſo what they grant, amounteth to as much as we require; though at the firſt they go about to exclude it.

3. The apprehenſion of things comming unto us by our ſenſes, are reſolvable into other more ſimple apprehenſions.

Having thus concluded, that when we apprehend any thing, that very thing is in us; let us in the next place examine, how it cometh thither, and what it is there. Which we ſhall beſt do, by anatomiſing, and looking narrowly into the nature of ſuch apprehenſions, as we daily make of things. It is true, we ſaid even now, that we cannot divide the actions of mans mind, farther then into apprehenſions; and therefore we called them ſimple and uncompoſed: and with good reaſon; for if we reflect upon the operations of our mind, we ſhall evidently perceive, that our bare apprehenſions, and only they, are ſuch: but withal we muſt acknowledge, that all the apprehenſions we make of things comming unto us by our ſenſes, are compoſed of other more ſingle apprehenſions, and may be reſolved into them; all which are as it were the limbs and parts, that make up and conſtitute the other total one.

4. The apprehenſion of a *being* is the moſt ſimple and *baſis* of all the reſt.

Let us make uſe of our former example, and diſſect the apprehenſion we make of a knife: I finde in my underſtanding that it is a thing ſo long, ſo broad, ſo ſharp, ſo heavy, of ſuch a colour, ſo moulded, ſo tempered, &c. as is fit to cut withal. In this total

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apprehenſion, I diſcover three kinds of particular apprehenſions, every one more ſimple and refined than the other. The higheſt of them, and the foundation upon which the others are built, is the notion of *being*: which is of ſo high, and of ſo abſtracted a nature, that we cannot retrive words to expreſs in what manner we conceive it; but are faln to content our ſelves with the outward ſound of a word, by which, without deſcribing our own, we ſtir up the like conception in another: and that is the word *is*; by which we intimate the *being* of the thing we apprehend. And this notion can be in our mind, without inferring any other; and therefore is the ſimpleſt of all others: which of neceſſity, muſt imply it, and cannot be without it, although it can be without them.

5. The apprehenſion of a *thing*, is the next degree to that of *being*, and it is the *Baſis* of all the ſubſequent ones.

Our next appehenſion is of that which hath *being*: and is expreſſed by the word *thing*. This is not ſo ſimple as the former, for it is compoſed of it, and of what receiveth it; of *being*, and of *what hath being*: yet it is much ſimpler than the next degree of apprehenſions, which is cauſed in our mind by the great variety of things, that come thither through our ſenſes; and can be conceived without any of them, though none of them can without it; for I can have in me the notion of *a thing*, abſtracting from all accidents whatſoever; as of magnitude, of figure, of colour, of reſemblance, or the like: but I cannot conceive it to be long, or ſharp, or blew, &c. without allowing it firſt to be *ſomewhat* or *ſomething*, that is in ſuch ſort affected: ſo that the apprehenſion of a *thing*, or of that which *hath being*, is the Baſis of all our other ſubſequent apprehenſions; as the apprehenſion of *being*, is the baſis of the apprehenſion of *a thing*: for had it not *being*, it were not a *thing*; and were it not a *thing*, it could not be ſaid to be a *long thing* or *a ſharp thing*; nor indeed that it were *long or ſharp*; for to be ſo, doth include *being*; and what hath *being*, is a *thing*. And thus we may obſerve, how the bulk of our apprehenſions is compoſed of ſomething adventitious, and of ſomething formerly within us, which is of a very different nature from all the others; and yet ſo fitted and neceſſary to them, that none of them can be without it, although it not onely can be, but is beſt conceived without relation to any of them.

6. The apprehenſion of things known to us by our ſenſes, doth conſiſt in certain reſpects betwixt two things.

We ſhall eaſily diſcern, of how different a ſtrain this conception of *being*, is from all others, that enter by our ſenſes, (as from

the conceptions of colours, of ſounds, and the like) if we but reflect upon that act in us, which maketh it; and then compare it with the others: for we ſhall find, that all they do conſiſt *in*, or *of* certain reſpects betwixt two things; whereas this of *being*, is an abſolute and ſimple conception of it ſelf, without any relation to ought is elſe; and cannot be deſcribed or expreſſed with other words, or by comparing it to any other thing; only we are ſure, we underſtand and know what it is.

But to make this point the clearer, it will not be amiſs, to ſhew more particularly, wherein the other ſorts of apprehenſions are different from this of *being*; and how they conſiſt in certain reſpects, between different things, and are known onely by thoſe reſpects: whereas this known onely in it ſelf; abſtracting from all other things whatſoever. An example will do it beſt: when I apprehend the *whiteneſs* in the wall, I may conſider how that white, is a thing which maketh ſuch an impreſſion upon my fantaſie; and ſo accordingly, I know or expreſs the nature of *white*, by a reſpect or proportion of the wall to work upon my fantaſie. In like manner, if we take a notion that ariſeth out of what entreth immediatly by our ſenſes, (for by joyning ſuch alſo to the notion of *being*, we make ordinary apprehenſions) we ſhall finde the ſame nature: as when I conſider how this white wall, is *like* to another white wall, the apprehenſion of *likeneſs* that I have in my mind, is nothing elſe, but a notion ariſing out of the impreſſion, which both thoſe walls together, do make upon my fantaſie; ſo that, this apprehenſion is as the former, a certain kind of reſpect or proportion of the two walls to my imagination: not as they make their impreſſions immediately upon it, but as another notion ariſeth, out of comparing the ſeveral impreſſions, which thoſe two white walls made in it.

7. Reſpect or relation hath not really any formal being, but only in the apprehenſion of man.

Let us proceed a little farther, and examine what kind of thing that is, which we call *reſpect* or *proportion*, and where it reſideth. We ſhall find, that there is a very great difference, between what it is in it ſelf, or in its own eſſence, and what it is in the things that are reſpective: for in them, it is nothing elſe but the things, being plainly and bluntly what they are really in themſelves: as for example, two white walls to be like, is in them nothing elſe, but each of them to be white: and two quantities to be halt and whole, is in them nothing elſe, but each quantity to be juſt what it

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is. But a *respect* in its own nature, is a kind of tye, comparison, tending, or order, of one of those things to another; and its no where to be found in its formal subsistence, but in the apprehension of man: and therefore it cannot be described by any similitude, nor be expressed by any means, but (like *being*) by the sound of a word, which we are agreed upon to stir up in us such a notion; for in the things, it is not such a thing as our notion of it is: (which notion is that, which we use to express by Propositions and conjunctions, and which *Aristotle* & Logicians express in common, by the word *ens*, or *ad*) and therefore there is nothing out of us, to paint it by: as I could do *white*, or *square*, or *round*, or the like; because these have a being in the things that are white, or square, &c. and consequently they may be expressed by others of the like nature: but the *likeness* that one white hath to another, or the *respect* that either of them hath to mans imagination, is only the Man; who by comparing them, giveth birth to the nature and Being of *respect*.

8. That *existence* or *being* is the proper affection of man: and that mans soul is a comparing power.

Out of this discourse, we may collect two singularities of man; which will much import us, to take particular notice of: the one is, that *being* or a *thing* (the formal notion of which is meerly *being*) is the proper affection of man; for every particular thing is in him, by being (as I may say) grafted upon the stock of *existence* or of *being*: and accordingly we see, that whatsoever we speak of, we say is *something*: and whatsoever we conceive, we give it the nature of a *thing*; as when we have said, the wall is white, we frame *whiteness* as a *thing*: so did we immediately before speaking of *respect*, we took *respect* as it were a *thing*, and enquired *where* it is: so that it is evident, that all the negotiation of our understanding, tradeth in all that is apprehended by it, as if they were *things*.

9. A thing by coming into the understanding of man, loseth nothing of its own peculiar nature.

The other singularity we may observe in man is, that he is a *comparing power*; for all his particular knowledges, are nothing else but *respects* or *comparisons* between particular things: as for example, for a man to know heat, or cold, &c. is to know, what effects fire or water, &c. can work upon such or such bodies.

Out of the first of these properties it followeth, that what affecteth a man, or maketh impression upon his understanding, doth not thereby lose its own peculiar nature, nor is it modified to the recipient; the contrary of which, we see happeneth perpetually

petually in bodies: observe the sustenance we take; which that it may be once part of our body, is first changed into a substance like our body, and ceaseth being what it was: when water or any liquid body is received into a vessel, it loseth its own figure, and putteth on the figure of the vessel it is in: if heat entreth into a body that is already hot, that heat becometh thereby more heat; if into a cold body, it is converted into warmth; & in like manner, all other corporeal things are accommodated to the qualities of the recipient; and in it, they lose their own proper terms and consistences: but what cometh into the understanding of a man, is in such sort received by him, or joyned to him, that it still retaineth its own proper limitations & particular natures notwithstanding the assumption of it unto him: for *being* is joyned to every thing there, since (as we have said) it is by *being* that any thing cometh thither: and consequently this stock of *being*, maketh every graft that is inoculated into it, *be* what of its own nature it is; for *being* joyned to another notion, doth not change that notion, but maketh it be what it was before; hence if it should be changed, *being* were not added to it: as for example, add *being* to the notion of *knife*, and it maketh a *knife*, or that notion, to *be* a *knife*: and if after the addition, it doth not remain a *knife*, it was not *being*, that was added to a *knife*.

10. A multitude of things may be united in mans understanding without being mingled or confounded together.

Out of the later of the singularities proper to man, it followeth, that multitude of things may be united in him without suffering any confusion among themselves; but every one of them, will remain with its proprieties, and distinct limitations: for so of necessity it must be, when that which uniteth them to him, is the comparing of them to something besides themselves: which work could not be performed, unless what is to be compared, do retain exactly its own nature, whereby the comparison may be made: no more than one can weigh two quantities one against another, unless he keep asunder what is in each scale, and keep all other weights from mingling with them: and accordingly we see that we cannot compare black to white, or a horse to an oxe, unless we take together, the properties by which black differeth from white, or an oxe from a horse: and consequently, they must remain unmingled and without confusion, precisely what in themselves they are, and be different in the sight of the comparer.

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But indeed, if we look well into the matter, we shall find, that setting aside the notion of *existence* or of *being*, all our other notions are nothing else, but *comparisons* and *respects*: and that by the mediation of *respects*, the natures of all things are in us: and that by the varying of them, we multiply our notions, which in their first division, that reduceth their several kinds into general heads, do increase into the ten famous Tribes, that Logicians call *predicaments*: and they do comprehend under them, all the particular notions that man hath, or can have, according to the course of knowledge in this life. Of which *predicaments* the seven last are so manifestly respective, that all men acknowledge them to be so. *Substance* we have already shewed to have a respect unto *being*, *quantity* we proved in the first Chapter of the former Treatise of the nature and of the operation of Bodies, to consist in a respect unto parts. *Quality* is divided into four branches: whereof *Power* is clearly a respect to what over which it hath power, or from which it may suffer. *Habit* is a respect to the substance wherein it is; as being the property by which it is well or ill, conveniently or inconveniently affected, in regard of its own nature; as you may observe in health, or sickness, or the like. The *passible qualities* are those which we have explicated, in discoursing of the Elements and of Mixts; and whose natures we have there shewed do consist in respects of acting or suffering. *Figure* or *shape* (which is the last branch of the division of the Predicament of Quality) is nothing else, but a certain disposition of one part of a body to another. And so you see, how all the ten *predicaments* do consist purely in diversity of *respects*: and by consequence, all our conceits and notions (excepting that of *being*, which is the stock, upon which all the rest are grafted) are nothing else, but various respects; since all of them whatsoever, are comprised under those general heads. Concerning which, we shall not need to dilate our selves any farther; seeing they are to be found in *Aristotle*, and in his Commentators, largely discoursed of.

II. Of abstracted and concrete terms.

In the next place, let us observe, how our understanding behaveth it self, in considering and in apprehending these respects. We have already declared, that the variety of our notions doth arise out of the respects which divers things have to one another: hence will follow, that of the same thing, we may have various notions

notions: for comparing it to different things, we ſhall meet with different reſpects between them; and conſequently, we ſhall conſider the ſame thing, under different notions: as when we conſider an apple, under the notions of greenneſs, of ſweetneſs, of roundneſs, of mellowneſs, &c. in ſuch ſort, as we have amply declared in the firſt Treatiſe, and therefore need not here enlarge our ſelves any farther upon this particular. Now theſe notions are ſo abſolutely ſevered one from another, and every one of them hath ſuch a compleatneſs within it ſelf, that we may uſe any one of them, without medling at all with any of the others. And this we do two ſeveral waies: the one, when our manner of apprehenſion determineth us to one preciſe notion, which is ſo ſummed up within it ſelf, as it not onely abſtracteth from all other notions, but alſo quite excludeth them, and admitteth no ſociety with them. The other way is, when we conſider a thing under a determinate notion, yet we do it in ſuch a manner, that although we abſtract from all other notions, nevertheleſs we do ſo, rather by neglecting, than by excluding them: and even in the manner of our expreſſion of it, we inſinuate that there are other notions (without ſpecifying what) belonging unto it.

Of the firſt kinde of notions, are whiteneſs, weight, heat, and ſuch like, (whoſe names are called *abſtracted termes*) which although they ariſe out of our comparing of the things that are white, heavie, hot, &c. to our fantaſie, or to other things; yet theſe notions are ſo preciſe, and ſhut up within themſelves, that they abſolutely exclude all others, (as of long, ſhort, ſquare, rough, ſharp, or whatſoever elſe) which may in the things accompany the whiteneſs, weight, heat, &c. that our conſideration is then buſied only with all. Of the ſecond kind of abſtracted notions, are white, heavie, hot, &c. (whoſe names, expreſſing them, are called *concrete termes*:) which although they cauſe in us no other apprehenſions than of whiteneſs, of weight, of heat, &c. yet they are not ſo rigorouſly paled in, as the others are, from admitting ſociety with any beſides; but do imply tacitely, that the thing which is white, heavie, hot, &c. hath beſides that, ſome other conſideration belonging unto it (whatſoever it be) which is not expreſſed.

Now in this latter abſtraction, it happeneth ſometimes, that the notion expreſſed, hath but an accidental connexion with

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the other notions, that are in the thing unexpressed: as for example, it is meerly accidental to the white wall as it is *white*, to be high or low, of stone, of plaister, or the like. But otherwhiles, the expressed notion is so essential to the concealed ones, that they cannot be without it: as when we apprehend a cloven foot, although this apprehension do abstract from all other notions besides *clovenfootedness* (if so I may say) yet, (as above we have declared) it is in such a manner, that it implieth other considerations, not yet expressed, in that cloven foot: among which, some may be of that nature, that they cannot have a Being without presupposing clovenfootedness; but others may be meerly accidental to that notion: as (for instance sake) let one be, *that the foot is cloven into three parts*; and let another be, *that it is black or hairy*; of these, this latter notion of *black or hairy*, is of the first kinde of abstractions, which we said had but an accidental connexion with that which comprehended them without expressing them: for other things besides the cloven foot, may be black or hairy; in such sort as height or lowness, to be of stone or of plaister, may belong unto other structures besides the white wall: but to be *cloven footed into three parts*, doth so necessarily depend of being cloven footed in general, (which implieth this particular) and so directly includeth it, as it cannot subsist without *clovenfootedness*: for though we may conceive a foot to be cloven, without determining in our apprehension, into how many toes it is cloven; yet we cannot conceive it to have three, four, or five toes, without apprehending it to be cloven: so that in such like apprehensions, the notion which is expressed, is so essential to the notion that is concealed and added unto it, as the concealed one cannot be conceived without the expressed one; and whensoever it is mentioned, the other is necessarily also brought in, and affirmed with it.

12. Of universall notions.

Now, some of these later kinds of notions, (in which what is expressed is essential to what is concealed) may be of such a nature as to be capable of receiving the addition of sundry other notions, so repugnant unto one another, that they cannot agree together in one subject; and yet that general notion, without determining any of the others, be indifferent to the contrary additions that include it, and belong as much to any one, as to any other of them:

them: and so consequently, whatsoever may be affirmed, and is true, of the primary notion, may as well be affirmed, and is as true, of the several particulars, arising out of the repugnant additions. Such a notion, Logicians term an *universal* one: that is, one that reacheth indifferently and equally to all the particulars comprised under it. As for example: to the notion of a living creature, may be added the notions of *reasonable* and *unreasonable*: which first notion, when it is barely expressed, it determineth no one of the two secondary notions, more than it doth the other: but is alike indifferent to either; and whatsoever belongeth to a living creature, belongeth entirely both to a man and to a beast: yet no one thing, can be both *reasonable* and *unreasonable*. In like manner when I say, *a man is a discursive creature*; under this word *man*, there lieth a notion, by which may be signified any particular man, as *Thomas*, *John*, *William*, &c. though of it self, it determine no one man whatsoever: and consequently, every one of these particular men, must be allowed to be a discursive creature; because the being such, belongeth unto the notion of *man*, and that notion unto all the particulars of *Thomas*, *John*, *William*, &c. and yet no particular man can be both *Thomas* and *John*, or *John* and *William*, &c.

In this kind of notion, we may observe yet one propriety more: which is, that of it self, and in its common term, it doth not cause ones thought to range unto several objects; nor doth imply that there are many particulars comprised under it: yet if there be never so many, that conceit will fit them every one; and if there be but one, still it will be no less accommodated to that one. As for example: He that maketh a right apprehension of a *sun*, doth not by that conception determine, whether there be many suns or but one: and if every one of the stars (which we call fixed) be suns to other earths, it fitteth them all; and if there be no other sun, than that which shineth to us, it is satisfied and taken up with that: so likewise, before the production of *Eve*, the notion of a *man* was as fully taken up by *Adam* alone, as it is now by his numerous progeny that filleth the world: nor doth our understanding, when that term is pronounced, consider (out of the force of the terms) whether there be many men, or onely one.

13. Of apprehending a multitude under one notion.

Another propriety in mans apprehension not much unlik:

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so this, is, that he is able to compriſe a multitude in one indiviſible notion, and yet, that notion expreſſ: the multiplicity of what it containeth: as we ſee in numbers, where the indiviſible conception of *ten*, *a hundred*, *a thouſand*, &c. doth plainly expreſſe the ſubject to be many; and yet that notion of the number bindeth them up (as I may ſay) into one bundle, that in it ſelf admitteth no diviſion, nor will permit that the leaſt part be taken from it; for if it be, the whole bundle is deſtroyed and vaniſheth: as when I take *ten*, if one be diminiſhed from it, it is no longer *ten*, but *nine*. It fareth in like manner with the conceptions we frame of *All*, and *Every one*, as it doth with numbers; for if but one be deficient, it is but a part, and not *all*, or *every one*: ſo that theſe notions do inviſibly terminate a multitude. And like to this notion, is the name or term *whole*, in reſpect of things which as yet have not diviſion, but are capable of being divided; for it is ſo rigorous, that if the leaſt atome or thought be wanting, it is no longer the *whole*, but only a part.

14. The power of the underſtanding reacheth as far as the extent of *being*.

And this is as much as at preſent appeareth unto me needful to be ſaid, concerning ſingle apprehenſions: unleſſe I be permitted to adde for a concluſion, this little note, (which peradventure might have been more properly ſet down in another place, where we diſcourſed of *Being*, but that it occurred not then to me) that apprehenſion being rooted in the nature of *Being*, the power of it ſpreadeth it ſelf as far as the extent of *Being*: and conſequently reacheth to all things whatſoever; for whatſoever is a *thing*, hath *Being*; and that unto which *Being* doth not reach is nothing. *Nay*, it is not limited there, but graſpeth even at *nothing*, and aimeth to make a notion of it, and planteth its generation, by multiplying it ſelf by negations of whatſoever is. Hence we have the notions of deafneſs, of dumbneſs, of blindneſs, of lameneſs, of baldneſs, of death, of ſin, and of all evils whatſoever, by the want of ſuch goods, as are ſenſible unto us.

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THE SECOND CHAPTER.

Of Thinking and Knowing.

1. How a judgement is made by the understanding.

HAving thus declared the nature of ſingle apprehenſions, the method we have preſcribed our ſelves, requireth that we examine in the next place, what effect the joyning of them together may have; for from thence do ſpring *Enunciations* or *Judgements*; which are in the next rank after ſimple apprehenſions, and are the materials whereof *diſcourſes* are immediately framed: as when of the two apprehenſions of *knife* and of *ſharp*, we may make this enunciation, *the knife is ſharp*. In this enquiry the firſt thing that occurreth unto us, is to conſider, in what manner two differing ſimple apprehenſions, do become joyned to one another: and we ſhall finde, that they are not tyed together like ſeveral diſtinct things in one bundle, or like ſtones in a heap, where all that are compriſed under one multitude, are yet circumſcribed within their own limits, and thereby are wholly diſtinguiſhed from each other; but that they are as it were grafted upon one ſtock; which being common to both, giveth the ſame life to both: and ſo becomming one with each of them, maketh them be one and the ſame thing between themſelves. And this is the notion of *Being* or *Exiſtence*, in the ſubject we ſpeak of: which (as we have already ſhewed) is the Baſis and foundation of all other apprehenſions; and by being common and indifferent to all, is the fitteſt glew to unite thoſe that are capable of ſuch conjunction: and accordingly we ſee, that moſt of our ſpeech runneth upon this ſtrain, that *this is that*, or *doth that*, (which is as much to ſay as *is doing that*) that *Socrates is a man*, or that *Socrates runneth*, (which ſignifieth, *is running*) and the like: and ſince our ſpeech proceedeth from the conceptions of our mind; it is clear, that as the words which expreſſe *Being* or *Exiſtence*, do joyn together the other words that we uſe, (or at leaſt, the greateſt part of them) ſo likewiſe in our mind the apprehenſion of *Being*, is the glew that joyneth our apprehenſions, correſponding to our words.

All which will appear to be ſaid with great reaſon, if we reflect upon it; for when diverſe apprehenſions may be thus joyned together, it is indeed, that one and the ſame thing affecting us ſeveral

veral waies and under different considerations; those indifferent expressions do beget different apprehensions in us: and so, till we examine the matter, every one of them seemeth to be a different thing: but when we trace these streams up to the fountain-head, we discern that all of them do belong to one and the same thing; and that by being in that thing, they are among themselves the very same thing, however they affect us variously; and therefore may truly be said to be one, as indeed they are: and consequently, nothing is more fit to joyn together in our minde those different apprehensions, than the apprehension of *Being*; which maketh us apprehend as one thing, those notions which really, and in the thing it self, are but one, as we have often touched, both in the former Treatise, and lately in this: for this is the way to joyn things in the minde intelligently, and according to the proper nature of the minde; which receiving impressions from things existent, ought to consider those impressions as they flow from the very things, and not as they are in the minde it self; and by mediation of those impressions, must take a survey of the things themselves; and not stay at the intellectual impressions they make in her: and consequently, must apprehend those things to be one in themselves, (although in us they be not so) according to the course of our original and legitimate apprehensions of things; which is, as they are existent; that is, as they are in their own nature, and in themselves; and not according to the discourses and secondary apprehensions we make of the images we finde of them in our minde. And thus things are rightly joyned by apprehension; without caution in which particular, we shall run into great errours in our discourse: for if we be not very careful herein, we are apt to mistake the use of the impressions we receive from things, and to ground our judgements concerning them, according to what we finde of them in our minde, and not according to what they are in themselves: which two several Considerations, have quite different faces; although (it is true) those impressions are made by the things, and are the only means by which we may rightly judge of them: provided, that we consider them as they are in the things, and not as they are in us.

Now this conjunction of apprehensions, by the mediation and the glew of *Being*, is the most natural and fitting, not only in regard

regard of the things, but even in regard of us: for (as we have already ſhewed) it is of all others the moſt common and univerſal, the moſt ſimple or uncompoſed, and the moſt natural and deepeſt rooted in man: out of all which, it is evident, that this union of apprehenſions by the means of *Being*, is in truth an identification of them: for Unity being a negation of multiplicity, it followeth, that what is one, is the ſame: and this identification is truly and naturally expreſſed by ſaying, that *the one is the other*.

3. How the notions of a ſubſtantive and an adjective, are united in the ſoul, by the common ſtock of *being*.

But inſiſting a little further upon this conſideration, how different apprehenſions become joyned and united together, by the notion of *Being*; we may obſerve that this happeneth, not only to two ſingle ones, but to more; according as more then two, may belong unto one thing: and it may ſo fall out, that more then one, be on either ſide the common ligament. Thus when we ſay, *A Man is a diſcourſive creature*; or *a Rational ſoul, is an immortal ſubſtance*, the two apprehenſions, of *diſcourſive*, and of *creature*, are joyned together in a third of *Man*, by the tye of one *Being*: and the two apprehenſions of *Immortal*, and of *Subſtance*, are united to the two others of *Rational* and of *Soul*, likewiſe by the ligament of one ſingle *Being*. Evident it is then, that the extremes are united by one *Being*: but how the two apprehenſions that are ranked together on the ſame ſide of the ligament (as in our former examples, the apprehenſions of *diſcourſive* and of *creature*, of *Rational* and of *Soul*, of *Immortal* and of *Subſtance*) are between themſelves joyned to one another, is not ſo eaſie to expreſſe. It is clear, that it is not done by meer conglobation; for we may obſerve, that they do belong, or are apprehended to belong, unto the ſame thing; and the very words that expreſſe them, do intimate ſo much, by one of them being an adjective; which ſheweth, they are not two things; for if they were, they would require two ſubſtantives to deſcribe them: and conſequently it followeth that one of them muſt needs appertain to the other: and ſo both of them make but one thing.

And there is no doubt, but in the inward apprehenſion, there is a variety correſpondent to the variety of words which expreſſe it; ſince all variety of words that is made by intention, reſulteth out of ſome ſuch variety of apprehenſions. Therefore, ſince the words do import, that the things have a dependance the one of the

the other, we cannot doubt, but that our apprehensions have so too: which will be conceived best, by looking into the act of our minde, when it frameth such variety of apprehensions belonging to one thing, correspondent to the variety in words of an *adjective* glewed unto his *substantive*; and attending heedfully to what we mean, when we speak so. The Hebrews do expresse this union, or comprising of two different apprehensions under one notion, by putting in the genitive case, the word which expresseth one of them, (much like the Rule in *Lilly*'s Grammar, that when two substantives come together, if they belong to the same thing, the one is put in the genitive case.) As when in the Scripture we meet with these words, *the judge of unjustice, the spence of wickedness, the man of sin,* or *of death*; which in our phrase of speaking, do signifie an unjust Judge, a wicked spence, and a sinfull or dead man. In which it is evident, that as well the manner of understandings as of speaking, taketh each paire of these notions to belong unto one thing; that is, to have both of them, one and the same *existence*, although there intervene not the formal expression of their being one. Thus we see, how one *being* serveth two different waies to joyn and unite several apprehensions: and if we will examine all the negotiations of our understanding, we shall hardly finde any notions so far distant, but may be brought together, either by the one of these waies, or by the other.

4. That a settled judgement betweth a part of our soul

But this composition and joyning of several apprehensions by the glew of *being*, is not sufficient to make us deem a thing to be really such, as their union painteth in the mind, or as the words so tied together do expres in speech. Well may it cause us to think of the thing; but to think, or to deem it such an one, (which word of *deeming* we shall be obliged henceforward to use frequently, because the word *thinking* is subject to equivocation) requireth the addition of something more, than barely this composition of apprehensions; which unless they be kept straight by some level, may as well swerve from the subject, as make a true picture of it. Here then we are to examine, what it is that maketh us think any thing to be such as we apprehend it: this we are sure of, that when we do so, our actions which proceed upon reason, and which have relation to that thing, are governed and steered in every circumstance, just as the thing were truly so:

as for example, if a man do really deem the weather to be cold, or that his body is distempered, he putteth on warmer clothes, or taketh physick; although peradventure he is mistaken in both: for his deeming them to be so, maketh him demean himself in such sort, as if really they were so. It is then evident, that by such thinking or deeming, the nature conceived, is made an active principle in us: unto which if we add, that all the knowledge we have of our soul, is no more, but that it is an *active force* in us, it seemeth, that a thing, by having apprehensions made of it in our mind, and by being really thought to be agreeable to such apprehensions, becometh (as it were) a part or affection of our soul, and one thing with it. And this peradventure is the cause, why an understanding man cannot easily leave an opinion once deeply rooted in him; but doth wrestle and strive against all arguments that would force him from it, as if a part of his soul or understanding were to be torn from him: in such manner as a beast will cry and struggle to save his body, from having any of his limbs disjoynted or pulled in pieces.

5. How the soul cometh to deem or settle a judgement.

But this observing the effect which followeth of our deeming a thing to be thus or so, is not sufficient to inform us, what it is that causeth that deeming. We must therefore take the matter a little higher, and look into its immediate principles: and there we shall finde, that it is the knowing of what we say to be true, and the assurance, that the things are as we deem them, which quieteth our soul, and maketh it consent unto them, and proceed to action upon that consent. Now this knowledge, is the most eminent part of deeming; and of all our acquisitions, is the most inseparable from us: and indeed in rigour, it is absolutely inseparable by direct means; however peradventure by indirect means it may be separated.

Let us then consider how we attaine unto it, and how sometimes we fail in the purchase of it; and what degrees of assurance or of probability there are between it and errour. To this intent, we may observe that the greatest assurance, and the most eminent knowledge we can have of any thing, is of such Propositions, as in the Schools are called *Identicall*; as if one should say, *John is John*, or *a man is a man*: for the truth of these Propositions is so evident and clear, as it is impossible any man should doubt of them, if he understand what he

he ſaith: and if we ſhould meet with one that were not ſatisfied of the verity of them, we would not go about to prove them to him, but would onely apply our ſelves to make him reflect upon the words he ſpeaketh, without uſing any farther induſtry to gain his aſſent thereunto; which is a manifeſt ſigne, that in ſuch Propoſitions, the apprehending or underſtanding them, is the ſame thing as to know them and to conſent unto them: or at the leaſt, that they are ſo neceſſarily conjoyned, as the one followeth immediately out of the other, without needing any other cauſes to promote this effect, more than that a man be diſpoſed, and willing to ſee the truth: ſo as we may conclude, that to underſtand a Propoſition which onely carrieth its evidence with it, is to know it. And by the ſame reaſon, although the evidence of a Propoſition, ſhould not at the firſt ſight be preſently obvious unto us, yet with unfolding and explicating of it, we come at length to diſcern it; then likewiſe the apprehending of it, is the knowing of it.

We muſt therefore enquire, what it is that cauſeth this evidence: and to that purpoſe, reflecting upon thoſe inſtances we have given of *Identical Propoſitions*, we may in them obſerve, that evidence ariſeth out of the plain Identification of the extremes that are affirmed of one another: ſo that, in what Propoſition ſoever, the Identification of the extremes is plain, the truth of it is evident unto us, and our mind is ſatisfied and at quiet; as being aſſured that it knoweth it to be ſo as the words ſay it. Now all affirmative Propoſitions do by the form of them import an Identification of their extremes, (for they all agree in ſaying, *This is that*) yet they are not all alike in the evidence of their Identification: for in ſome it ſheweth it ſelf plainly, without needing any farther help to diſcover it; and thoſe are without any more ado knowne of themſelves, as ſuch *Identical* ſayings, we even now gave for examples: others require a journey ſomewhat farther about, to ſhew their identification; which if it be not ſo hidden, but that it may in the end be diſcovered and brought to light, as ſoon as that is done, the knowledge ſetled by them in the ſoul, is certain and ſatisfactory as well as the other: but if it be ſo obſcure, that we cannot diſplay the Identification of it, then our minde ſuſpendeth his aſſent, and is

as for example, if a man do really deem the weather to be cold, or that his body is diſtempered, he putteth on warmer clothes, or taketh phyſick; although peradventure he is miſtaken in both: for his deeming them to be ſo, maketh him demean himſelf in ſuch ſort, as if really they were ſo. It is then evident, that by ſuch thinking or deeming, the nature conceived, is made an active principle in us: unto which if we add, that all the knowledge we have of our ſoul, is no more, but that it is an *active force* in us, it ſeemeth, that a thing, by having apprehenſions made of it in our mind, and by being really thought to be agreeable to ſuch apprehenſions, becometh (as it were) a part or affection of our ſoul, and one thing with it. And this peradventure is the cauſe, why an underſtanding man cannot eaſily leave an opinion once deeply rooted in him; but doth wreſtle and ſtrive againſt all arguments that would force him from it, as if a part of his ſoul or underſtanding were to be torn from him: in ſuch manner as a beaſt will cry and ſtruggle to ſave his body, from having any of his limbs disjoynted or pulled in pieces.

5. How the ſoul cometh to deem or ſettle a judgement.

But this obſerving the effect which followeth of our deeming a thing to be thus or ſo, is not ſufficient to inform us, what it is that cauſeth that deeming. We muſt therefore take the matter a little higher, and look into its immediate principles: and there we ſhall finde, that it is the knowing of what we ſay to be true, and the aſſurance, that the things are as we deem them, which quieteth our ſoul, and maketh it conſent unto them, and proceed to action upon that conſent. Now this knowledge, is the moſt eminent part of deeming; and of all our acquiſitions, is the moſt inſeparable from us: and indeed in rigour, it is abſolutely inſeparable by direct means; however peradventure by indirect means it may be ſeparated.

Let us then conſider how we attaine unto it, and how ſometimes we fail in the purchaſe of it; and what degrees of aſſurance or of probability there are between it and errour. To this intent, we may obſerve that the greateſt aſſurance, and the moſt eminent knowledge we can have of any thing, is of ſuch Propoſitions, as in the Schools are called *Identicall*; as if one ſhould ſay, *John is John*, or *a man is a man*: for the truth of theſe Propoſitions is ſo evident and clear, as it is impoſſible any man ſhould doubt of them, if he underſtand what he

he saith: and if we should meet with one that were not satisfied of the verity of them, we would not go about to prove them to him, but would onely apply our selves to make him reflect upon the words he speaketh, without using any farther industry to gain his assent thereunto; which is a manifest signe, that in such Propositions, the apprehending or understanding them, is the same thing as to know them and to consent unto them: or at the least, that they are so necessarily conjoyned, as the one followeth immediately out of the other, without needing any other causes to promote this effect, more than that a man be disposed, and willing to see the truth: so as we may conclude, that to understand a Proposition which onely carrieth its evidence with it, is to know it: And by the same reason, although the evidence of a Proposition, should not at the first sight be presently obvious unto us, yet with unfolding and explicating of it, we come at length to discern it; then likewise the apprehending of it, is the knowing of it.

We must therefore enquire, what it is that causeth this evidence: and to that purpose, reflecting upon those instances we have given of *Identical Propositions*, we may in them observe, that evidence ariseth out of the plain Identification of the extremes that are affirmed of one another: so that, in what Proposition soever, the Identification of the extremes is plain, the truth of it is evident unto us, and our mind is satisfied and at quiet; as being assured that it knoweth it to be so as the words say it. Now all affirmative Propositions do by the form of them import an Identification of their extremes, (for they all agree in saying, *This is that*) yet they are not all alike in the evidence of their Identification: for in some it sheweth it self plainly, without needing any farther help to discover it; and those are without any more ado knowne of themselves, as such *Identical* sayings, we even now gave for examples: others require a journey somewhat farther about, to shew their identification; which if it be not so hidden, but that it may in the end be discovered and brought to light, as soon as that is done, the knowledge setled by them in the soul, is certain and satisfactory as well as the other: but if it be so obscure, that we cannot display the Identification of it, then our minde suspendeth his assent, and is

unquiet about it, and doubteth of the truth of it: in ſome Propoſitions, whiles he ſearcheth and enquireth after the Identification of their extremes; peradventure he diſcerneth, that it is impoſſible there ſhould be any between them; and then on the other ſide, he is ſatisfied of the falſity of them: for if a Propoſition be affirmative, it muſt neceſſarily be a falſe one, if there be no Identication between the extremes of it.

By this Diſcourſe, we have found two ſorts of Propoſitions, which beget knowledge in us. The one, where the Identification of the extremes, is of it ſelf ſo manifeſt, that when they are but explicated, it needeth no farther proofs. The other, where though in truth they be identified, yet the Identification appeareth not ſo clear, but that ſome diſcourſe is required to ſatisfie the underſtanding therein. Of the firſt kind, are ſuch Propoſitions, as do make one of the extremes the definition of the other whereof it is affirmed: as when we ſay, *a man is a reaſonable creature*; which is ſo evident, if we underſtand what is meaned by a *man*, and what by *a reaſonable creature*, as it needeth no farther proof to make us know it: and knowledge is begotten in us, not onely by a perfect Identification of the extremes, but as well by an imperfect one: as when what is ſaid of another, is but part of its definition; for example, if one ſhould ſay, *a man is a creature*, no body that knoweth him to be a rational creature, (which is his compleat definition) could doubt of his being a creature; becauſe that the being *a creature*, is partly identified, to being a *rational creature*. In like manner, this obvious evidence of *Identification*, appeareth as well where a compleat diviſion of a thing is affirmed of the other extreme, as where the affirmation is made by the total or partial definition of it: as when we ſay, number is even or odd: an enuntiation is true or falſe, and the like: where, becauſe what is ſaid, compriſeth the differences of the thing whereof it is ſaid, it is plain that of them muſt needs be that whereof we ſpeak.

Peradventure ſome may expect, that we ſhould give *Identical Propoſitions* (among others) for examples of this plain evidence: but becauſe they bring no acquiſition of new knowledge unto the ſoul, (the doing of which, and the reflecting upon the manner, is the ſcope of this Chapter) I let them paſs without

out any farther mention, upon this occasion having produced them once before, only to shew by an undeniable example, what it is that maketh our soul consent unto an enunciation, and how knowledge is begotten in her, that we might afterwards apply the force of it to other Positions.

Let us therefore proceed to the second sort of Propositions, which require some discourse, to prove the Identification of their extremes. Now the scope of such discourse is, by comparing them unto some other third thing, to shew their Identification between themselves; for it sheweth, that each of them apart is identified with that new subject it bringeth in: and then our understanding is satisfied of their identity, and our soul is secure of that knowledge it thus acquireth, as well as it is of that which resulteth out of those Propositions, which bear their evidence in their first aspect.

This negotiation of the understanding to discover the truthe of Propositions, when it is somwhat hidden, (which we call *discourse*) as it is one of the chiefest and noblest actions of the soul, so doth it challenge a very heedful inspection into it: and therefore we will allow it a peculiar Chapter by it self, to explicate the nature and particularities of it. But this little we now have said concerning it, is sufficient for this place; where all we aim at is to prove (and I conceive we have done it very fully) that when *Identity* between two or more things, presenteth it self to our understanding, it maketh and forceth knowledge in our soul.

Whence it is manifest, that the same power or soul, which in a single apprehension is possessed with the *Entity* or *Unity* of it, is that very power or soul, which applyed to an *Enunciation*, knoweth or deemeth; since *knowing* is nothing else, but the apprehending of manifest Identity in the extremes of a Proposition, or an effect immediately consequent out of it, in the soul that applyeth it self to apprehend that Identity. Which apprehension is made, either by the force of the extremes, applyed immediately to one another, or else by the application of them to some other thing: which peradventure may require yet a further application unto new apprehensions, to make the Identity between the first extremes appear evidently.

6. How opinion is begotten in the understanding.

Now, as when *Identity* truly appeareth, it maketh evidence to our understanding, and begetteth assured knowledge in our soul;

soul; so, when there is only an apparent identity, but not a real one, it happeneth that the understanding is quieted without evidence; and our soul is fraught with a wrong or slight belief, instead of certain knowledge: As for example, it is for the most part true, that what wise men affirme, is so as they say; but because wise men are but men (and consequently not infallible) it may happen that in some one thing, the wisest men that are may misse, though in most and generally speaking, they hit right. Now if any body in a particular occasion, (should) without examining the matter) take this proposition rigorously and peremptory, by *that what wise men affirme is true*; and should thereupon subsume with evidence, *that wise men say such a particular thing*, and should thereupon proceed to believe it; in this case he may be deceived, because the first proposition is not verily, but only seemingly evident.

And this is the manner how that kinde of deeming, which is either opposed, or inferiour to knowledge, is bred in us: to wit, when either through temerity, in such cases where we may, and it is just we should examine all particulars so carefully, that no equivocation or mistake in any part of them, be admitted to passe upon us for a truth, and yet we do not; or else, through the limitedness and imperfection of our nature, when the minuteness and variety of petty circumstances in a business is such, as we cannot enter into an exact examination of all that belongeth to that matter, (for if we should exactly discusse every slight particular, we should never get through any thing of moment) we settle our understanding upon grounds that are not sufficient to move and determine it. Now in some of these cases, (and particularly in the *latter*) it may happen, that the understanding it self is aware, that it neither hath discovered, nor can discover evidence enough, to settle its assent with absolute assurance: and then it judgeth the belief it affordeth unto such a position, to be but probable; and instead of knowledge, hath but *opinion* concerning it. Which *opinion* appeareth to it more or lesse probable, according as the motives it relyeth on, are stronger or weaker.

7. How faith is begotten in the understanding.

There remaineth yet another kinde of deeming for us to speak of; which though it ever fail of evidence, yet sometimes is better then opinion, for sometimes it bringeth a certitude with it. This we call *Faith*, and is to be ranked in this sort: when we assent with

with a man, who knoweth ſomthing which we do not, if withall we be perſwaded that he doth not, nor will not tell a lye; we then believe what he ſaith of that thing to be true: now according to the perſwaſion we have of his knowledge and veracity, our belief is ſtrong, or mingled with doubt: ſo that if we have abſolute aſſurance and certainty, that he knoweth the truth and will not lye, then we may be aſſured, that the faith which we yield to what he ſaith, is certain as well as evident knowledge is certain, and admitteth no compariſon with opinion, be it never ſo probable: but ſo it may happen, that we may be certainly aſſured that a man doth know the truth of what he ſpeaketh of, & that he will not lye in reporting it to us: for ſeeing no man is wicked without a cauſe; and that to tell a lye in a ſerious matter, is a great wickedneſſe; if once we come to be certain that he hath no cauſe, (as it may fall out we may) then it followeth, that we are aſſured of the thing which he reporteth to us.

Yet ſtill ſuch faith falleth ſhort of the evidence of knowledge in this regard, that its evidence ſticketh one degree on this ſide the thing it ſelf: and at the puſh, in ſuch a caſe we ſee but with anothers eyes; and conſequently, if any oppoſition do ariſe againſt our thought thereabout, it is dot the beams, and the light of the thing it ſelf, which ſtrengthen us againſt ſuch oppoſition, but the goodneſs of the party upon whom we rely.

8. Why truth is the perfection of a reaſonable ſoul: and why it is not found in ſimple apprehenſions as well as in Enuntiations.

Before I go any farther, I muſt needs remember one thing, that our Maſters teach us: which is, that truth and falſhood are firſt found in ſayings or *Enuntiations*; and that although ſingle apprehenſions are in our minde before theſe judgements, yet are they not true or falſe themſelves, nor is the underſtanding ſo by them. To comprehend the reaſon of this maxime, let us conſider what truth and falſhood are: ſurely truth is nothing elſe, but the conformity of our underſtanding, with the things that make impreſſion upon it: and conſequently, falſhood is a diſagreeing between our minde and thoſe things: if the exiſtence which the things have in us, be agreeable to the Exiſtence they have in themſelves; then our underſtanding is true; otherwiſe it is falſe. Now the natural perfection of our Soul or underſtanding, is to be fraught with the reſt of the whole world, that is to have the knowledge of all things that are; the knowledge of their eſſences, of their natures, of their proprieties, of their operations, and

of whatſoever elſe belongeth to them all in general, and to every one of them in particular: but our ſoul cannot be ſtored or fraught with any thing, by other means then by her aſſent or deeming: whereupon it followeth, that ſhe cannot have her perfection, until her deemings or judgements be perfect; which is, that they be agreeable unto the things in the world: when they are ſo, then are they true. And this is the reaſon why truth is the aim, and perfection of the ſoul. Now then, truth reſiding only in the aſſents and judgements of the ſoul, (which are the traffick whereby ſhe enricheth her ſelf with the reſt of the world) and they being framed by her diſcerning an identity between two things; which ſhe expreſſeth by affirming one of them of the other: it followeth, that nothing can be true or falſe, but where there is a compoſition of two extremes, made by the ones being affirmed of the other; which is done onely in Enunciations or judgements: whiles ſingle apprehenſions aſſent to nothing, and therefore ſettle no knowledge in the ſoul; and conſequently are not capable of verity or falſity, but are like pictures made at fanſie, ſome one of which may happen to be like ſome Perſon, but cannot be ſaid to be the picture of him, becauſe it was not drawn from him: ſo theſe bare apprehenſions, becauſe there is not in the man union of the ſoul to the outward world, or to the Exiſtence which actuateth its object, therefore they make not the ſoul to be the image of the things exiſtent: but the judgement, which ſtill taketh a thing exiſtent, or as exiſtent, in the ſubject of the propoſition, draweth its picture from the thing it ſelf: and therefore it maketh the ſoul to be well or ill painted, in reſpect of the thing that is true or falſe.

And this is the reaſon, why in one ſenſe doubtful propoſitions, which the underſtanding (not being yet reſolved) maketh inquiringly to inform it ſelf of the truth of them, cannot be ſaid to be true or falſe; for all that while, the ſoul yieldeth no aſſent unto them, either one way or other; yet in another ſenſe they may, which is, taking them as ſubjects that the underſtanding determineth unto it ſelf to treat of: for there being two extremes in them, and the propoſition conſiſting in this, whether theſe extremes be identified or no, it followeth, that ſince one part muſt of neceſſity be, ſuch a propoſition ſpoken at random, or written by chance without deſign, is of neceſſity either

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tru: or falſe; according as the extremes of it, are or are not one thing.

9. What is a ſolid judgement, and what a ſlight one.

There occureth no more unto my conſideration to be ſaid in this place, concerning the aſſents and judgements of the minde: unleſs it be, to explicate in a word or two, the ſeveral qualities of them, which are found in ſeveral Perſons; and to point at the reaſon why they are called by thoſe names, which they are univerſally known by. To which purpoſe we may obſerve, that judgement or *deeming*, being a quieting of the minde, it followeth that the minde muſt needs be at diſquiet and at unreſt, before it commeth to judge: ſo that we may conclude, that judgement or thinking, is a good attained by a former motion. Now according to the quality of this motion, the judgement or aſſent, is qualified and denominated. We muſt therefore conſider what belongeth to motion; which when we have done, we ſhall in judgements finde ſomething proportionable thereunto.

We know there is a beginning and an ending in motion; and that there are parts by which it is drawn out in length: all which muſt be particularly conſidered, in our comparing of motions unto judgements. Now then, as he that would know preciſely the nature of any motion, muſt not begin his ſurvay of it, after it hath been ſome time in fluxe; nor muſt give over his obſerving it, before it have arrived unto its utmoſt period; but ought to carry his attenſion along from its firſt origine, and paſſe with it through all its parts, until it ceaſing, give him leave to do ſo too (for otherwiſe, it may happen that the courſe of it be differing in thoſe parts he hath not obſerved, from thoſe that he hath, and accordingly, the preſture he ſhall make of it by that imperfect ſcantling, will prove an erroneous one;) ſo in like manner, when a man is to make a *judgement* of any matter in queſtion, to give a good account of it, he muſt begin at the root, and follow ſucceſſively all the branches it divideth it ſelf into, and drive every one of them to their utmoſt extremity and period: and according as in judging he behaveth himſelf well or ill, in the ſeveral circumſtances that are proportionable to the beginning, ending, and parts of motion; ſo his judgement is qualified with the names of ſeveral vertues agreeing thereunto, or of their oppoſite defects.

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If he begin his conſiderations very low, and from the very bottom and root of the affair, which is from the firſt and all comprehending principles of the queſtion, and proceed on orderly taking all before him; his judgement is accounted *deep, profound, and ſolid:* for he that caſteth ſo far, as to leave behinde him no part of the matter he is inquiring about, & then driveth his courſe ſteadily and ſmoothly forwards, without any leaps over rugged paſſages, or interruptions, or looſe breaches; muſt of neceſſity make a well grounded judgement; and ſuch an one, as cannot eaſily be overthrown, or he be eaſily removed from it.

And this is indeed the full reaſon, of what a little above we only glanced at: namely, why underſtanding men are uſually accounted obſtinate in their tenets, and are hard to be removed from their opinions once ſettled in their mindes: for when other men oppoſe them, they urge nothing (for the moſt part) againſt theſe judicious mens reſolutions or beliefs, but what they have already throughly foreſeen: but theſe on the other ſide, do ſee a great deal, that their oppoſers reach not unto; ſo that notwithſtanding all ſuch oppoſition, they continue ſtill unſhaken in their *judgements:* for which, the others which ſee not as much as they do thinke them obſtinate, and not led by reaſon, becauſe they follow not that ſhort reaſon, beyond which themſelves cannot reach.

The contrary vice to this, is called a *ſlight judgement:* and conſiſteth herein, that a man out of a few, and an inſufficient number of circumſtances, reſolveth the whole caſe: which temerity and ſhort ſightedneſs of judgement, is ſignificantly taxed in our Engliſh proverb, that *a fools bolt is ſoon ſhot.*

10. What is an acute judgment and what a dul one.

Thus much for the beginning of a judgement: the next conſideration may be concerning the end of it; in regard whereof, if it reach to the utmoſt extent and period of what is conſiderable in a hard queſtion propoſed, it gaineth the title of *ſharp*, or of *ſubtile*, and *acute*; for the hardneſſe of the matter that perplexeth ones judgement, conſiſteth in the involution of things, which looked upon ingroſſe, do ſeem to have no diſtinction or oppoſition among themſelves; and yet are in truth of very different and contrary natures. Now a good judgement divideth and cutteth through them, and alloteth unto every particular thing its proper limits and bounds: wherefore, as in corporeal ſubſtan-

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ces, the vertue of dividing is sharpness and edge, by translation from thence, such a judgement as pierceth neatly and smartly between contradictories that lie close together, is called *sharp* and *acute*. In like manner, *subtility* is a vertue, whereby a liquor or other body searcheth every little hole and part of what it worketh upon, till it get through it; and from thence, it is used in judgements to signifie the same: whose opposite vice is called *dulness*.

11. In what consisteth quickness and clearness of judgement: and their opposite vices.

In the last place we are to examine, what proportion a judgement holdeth with the parts of motion: in these, two things are to be considered, namely the quantity or multitude of those parts, and the order of them. As for the quantity in a motion, it belongeth either to long or short, or to quick and slow: now, where the beginning and ending are already known and determined, and consequently where the length is determined, and dependeth not at all of the judge to alter it, (for he must take it as the matter giveth it) there a judgement can acquire no denomination of perfection or deficiency, from length or from shortness; for they belong originally to the matter of the judgement; and the judgement must accordingly fit it self to that; and therefore is liable neither to commendations nor to reproach, for being long or short: it remaineth then, that the vertue in *judging* answerable to the quantity of motion, must consist in quickness and celerity; and the contrary vice, in slowness and heaviness.

As for order in the several parts of motion, we know that if they be well ordered, they are distinct and easily discernable. Which vertue, in our subject, is called *clearness of judgement*; as the contrary vice is *confusion*.

THE

THE THIRD CHAPTER.

Of Diſcourſing.

1. How diſcourſe made.

IN the laſt Chapter we have ſhewed, how two apprehenſions joyned together do make a judgement: now in this our firſt emp'oyment will be, to ſhew how three of theſe Thoughts or Judgements, well choſen and duely ordered, do compoſe the firſt and moſt ſimple of pe fect diſcourſes; which Logicians call a Syllogiſm: whoſe end and effect is to gain the knowledge of ſomething, before hidden and unknown. The means whereby this is compaſſ.d, is thus. By the two firſt judgements, we joyn the extremes of the propoſition we deſire to know, unto ſome third thing; and then, by ſeeing that they both āre one third thing, and that one can be but one, we come to diſcern, that truly one of them is the other; which before we ſaw not: ſo that, the *identity*, which firſt made an identical propoſition be known and agreed unto, and afterwards cauſed the like aff.nt to be yielded unto thoſe maximes, whoſe identifi. cation preſently ſhewed it ſelf, now by a little circuit and bringing in of a third term, maketh the two firſt (whoſe identification was hidden and obſcure, whiles we looked upon the terms themſelves) appear to be in very truth but one thing.

2. Of the figures and moods of Syllogiſms.

The various mingling and diſpoſing of theſe three terms in the two firſt propoſitions, begetteth a variety in the ſyllogiſms that are compoſed of them: and it conſiſteth in this, that the aſſumed term unto which the other two are interchangeably joyned, is either ſaid of them, or they are ſaid of it: and from hence ſpring three different kindes of ſyllogiſms; for either the aſſumed or middle term, is ſaid of both the other two; or both they are ſaid of it; or it is ſaid of one of them, and the other is ſaid of it: neither is there any deeper myſtery then this, in the three figures, our great Clerks talk ſo much of: which being brought into rules, to help our memory in the ready uſe of this tranſpoſition of the termes; if we ſpin our thoughts upon them into over ſmall threds, and thereof weave too intricate webs (mean while not reflecting upon the ſolid ground within our ſelves, whereon theſe rules are built, nor conſidering the true end why;)

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we may spend our time in trivial and useless subtilities: and at length, confound and misapply the right use of our natural discourse, with a multiude of precepts drawn from artificial Logick.

But to return to our matter in hand; under this primary threefold variety, is another of greater extent, growing out of the divers composition of the three terms, as they are qualified by *affirmation* or *negation*, and by *universality* or *particularity*: for that unity, which the two terms, whose identification is enquired after, must have, by being joyned with the third, becometh much varied by such divers application: and from hence shooteth up that multitude of kindes of syllogisms, which our Logicians call Moods. All which I have thus particularly expressed, to the end we may observe how this great variety hangeth upon the sole string of *identity*.

3. That the life of man as man, doth consist in discourse, and of the vast extent of it.

Now these Syllogisms, being as it were interlaced and woven one within another, (so that many of them do make a long chain, whereof each of them is a link) do breed, or rather are all the variety of mans life: they are the steps by which we walk in all our convertations, and in all our businesses: man as he is man, doth nothing else but weave such chains: whatsoever he doth, swarving from this work, he doth as deficient from the nature of man: and if he do ought beyond this, by breaking out into divers sorts of exteriour actions, he findeth nevertheless in this linked sequel of simple discourses, the art, the cause, the rule, the bounds, and the model of it.

Let us take a summary view of the vast extent of it, and in what an immense Ocean one may securely sail, by that never-varying Compass, when the Needle is rightly touched, and fitted to a well-moulded box; making still new discoveries of Regions, far out of the sight and belief of them, who stand upon the hither shore. Humane operations are comprised under the two general heads of *Knowledge* and of *Action*: if we look but in grosse, upon what an infinity of divisions these branch themselves into, we shall become giddy, our brains will turn, our eyes will grow weary and dim, with aiming only at a suddain, and roving measure of the most conspicuous among them, in the way of knowledge.

We see what mighty works men have extented their labours unto;

unto; not only by wild diſcourſes, of which huge volums are compoſed, but even in the rigorous method of Geometry, Arithmetick, and Algepta; in which, an *Euclide*, an *Appollonius*, an *Archimedes*, a *Diophantus*, and their followers, have reached ſuch admirable heights, and have wound up ſuch vaſt bottoms, ſometimes ſhewing by effects, that the thing propoſed muſt needs be as they have ſet down, and cannot poſſibly be any otherwiſe; otherwhiles, appaying the underſtanding (which is never truly at reſt, till it hath found the cauſes of the effects it ſeeth) by expoſing how it cometh to be: ſo that the Reader calling to minde, how ſuch a thing was taught him before, and now finding another unexpectedly convinced upon him, eaſily ſeeth that theſe two put together, do make and force that third to be, whereof he was before in admiration how it could be effected: which two waies of diſcourſe, are ordinarily known by the names of *Demonſtrations*; the one called *à priori*, the other *à poſteriori*.

Now if we look into the extent of the deductions out of theſe, we ſhall finde no end. In the heavens, we may perceive Aſtronomy meaſuring whatſoever we can imagine; and ordering thoſe glorious lights, which our Creator hath hanged out for us; and ſhewing them their waies, and pricking out their paths, and preſcribing them (for as many ages as he pleaſeth before hand) the various motions they may not ſwarve from in the leaſt circumſtance. Nor want there ſublime ſouls, that tell us what metal they are made of, what figures they have, upon what pillars they are fixed, and upon what gimals they move and perform their various periods: witneſſe that excellent and admirable work, I have ſo often mentioned in my former Treatiſe. If we look upon the earth, we ſhall meet with thoſe, that will tell us how thick it is, and how much room it taketh up: they will ſhew us how men and beaſts are hanged unto it by the heels; how the water and air do cover it; what force and power Fire hath upon them all; what working is in the depths of it; and of what compoſition the main body of it is framed: where neither our eyes can reach, nor any of our ſenſes can ſend its meſſengers to gather and bring back any relations of it. Yet are not our Maſters contented with all this: the whole world of bodies is not enough to ſatisfie them: the knowledge of all corporeal

Dialo: de mundo.

real things, and of this machine of heaven and earth, with all that they encloſe, cannot quench the unlimited thirſt of a noble minde, once ſet on fire with the beauty and love of Truth.

Æſtuat infœlix, auguſto limite mundi,
Ut Gyarœ clauſus ſcopulis, parvâque Seripho.

But ſuch heroick ſpirits, caſt their ſubtile nets into another world, after the winged inhabitants of the heavens; and finde means to bring them alſo into account, and to ſerve them (how imperceptible ſoever they be to the ſenſes) as daintie at the ſouls table. They enquire after a maker of the world we ſee, and are our ſelves a main part of; and having found him, they conclude him (out of the force of contradiction) to be eternal, infinite, omnipotent, omniſcient, immutable, and a thouſand other admirable qualities they determine of him. They ſearch after his tools and inſtruments, wherewith he built this vaſt and admirable Palace, and ſeek to grow acquainted with the officers and ſtewards, that under him govern this orderly and numerous family. They finde them to be inviſible creatures, exalted above us more than we can eſtimate, yet infinitely farther ſhort of their and our Maker, than we are of them. If this do occaſion them to caſt their thoughts upon man himſelf, they finde a nature in him (it is true) much inferiour to theſe admirable *Intelligences*, yet ſuch an one, as they hope may one day arrive unto the likeneſs of them: and that even at the preſent, is of ſo noble a mould, as nothing is too big for it to faddom, nor any thing too ſmall for it to diſcern.

Thus we ſee knowledge hath no limits; nothing eſcapeth the toyls of Sciences; all that ever was, that is, or can ever be, is by them circled in: their extent is ſo vaſt, that our very thoughts and ambitions are too weak and too poor to hope for, or to aim at what by them may be compaſſed. And if any man, that is not inured to raiſe his thoughts above the pitch of the outward objects he converſeth daily with, ſhould ſuſpect that what I have now ſaid, is rather like the longing dreams of paſſionate lovers, whoſe deſires feed them with impoſſibilities, than that it is any real truth; or ſhould imagine that it is but a Poetick Idea of Science, that never was nor will be in act: or if any other, that hath his diſcourſing faculty vitiated and

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perverted, by having been imbued in the Schools with unſound and umbratile principles, ſhould perſwade himſelf, that howſoever the pretenders unto learning and ſcience, may talk loud of all things, and make a noiſe with Scholaſtick terms, and perſwade their ignorant hearers that they ſpeak and unfold deep myſteries, yet in very truth, nothing at all can be known: I ſhall beſeech them both to ſuſpend their conjectures or beliefs herein, and to reſerve their cenſure of me, whether or no I have ſtrained too far, untill the learned Author of the Dialogues of the world, have enriched it with the work he hath compoſed of Metaphyſicks: in which, going orderly and rigorouſly by continued propoſitions, in ſuch ſort as Mathematicians demonſtrate their undertakings, he hath left no ſcope for wrangling brains to make the leaſt cavil againſt his doctrine: and caſting his ſharp-ſighted thoughts over the whole extent of Nature, and driving them up to the Almighty Author of it, he hath left nothing out of the verge of thoſe rules, and all-comprehending principles he giveth of true Science. And then I doubt not, but they will throughly abſolve me from having uſed my amplification, in aiming at the reach of this algraſping power. For my part, the beſt expreſſion that I am able to make of this admirable piece, I muſt borrow from witty *Galileus*, when he ſpeaketh of *Archimedes* his long miſſed Book of glaſſes; and profeſſe, that having ſome of the Elements or Books of it entruſted in my hands by the Author, I read them over with extreme amazement, as well as delight, for the wonderful ſubtility, and ſolidneſs of them.

4. Of humane actions, and of thoſe that concern our ſelves

Thus much for Knowledge. Now let us caſt an eye upon humane actions. All that we do (if we do it as we ſhould do, and like men) is governed and ſtiered be two ſorts of qualities: the one of which, we call *Arts*; the other *Prudences*. An art, is a collection of general rules, comprehending ſome one ſubject, upon which we often work. The matters we work upon (out of which the particular ſubjects of Arts do ſpring) are of three kindes: our ſelves, our neighbours, and ſuch dumb or inſenſible things, as compoſe the reſt of the world.

Our actions upon our ſelves, are the higheſt and the nobleſt of all the reſt, and thoſe by which we live and work as men: or to expreſſe my ſelf better, they are thoſe by which we perfect

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that part of us, which maketh us men, and by which we direct and level all we do, according to the rule of reason; not suffering our actions to swarve from what she dictateth unto us. This is done, by multiplying and heightning the thoughts of those things, which maintain us in reason; whether the motives be moral, as the examples of worthy persons, and the precepts and perswasions of wise men, and the like, or whether they be natural, as the consideration of the sweet and contented life, which vertue giveth us here, by good conversation, honor, profit, quiet, pleasure, and what else soever groweth out of so excellent a root: as also, of the beatitude and happy state it bringeth us to in the next; and of the contrary effects which spring from vice. Again, by observing the motives and waies of our passions and animal desires, we learn how to prevent them; how to terrifie them; and how to wear them gently away by little and little, through sometimes giving them diversions, through otherwhiles restraining them with moderation, and through oftentimes cutting of the occasions, and abridging them of their natural encreasings. All these things are b ought into art and rule; whose lessons, were men but as careful and industrious to study, as they are to become Masters in vain and trivial things, they would enjoy happy lives.

5. Of humane actions as they concern our neighbours.

In the next place, we are to consider the actions whereby we work upon our neighbours. They are chiefly *government* and *negotiation:* both which are of one kinde; and have but this difference, that the one is done in common, the other is performed in particular. The means by which we command, are rewards and punishments which who hath in his hands, may assuredly by wise using them, bring to passe whatsoever he hath a minde unto.

Upon occasion of mentioning these two powerful motives, which have so main an influence in mens actions, we may note by the way, that many of them, and that work most forcibly upon mens mindes, are things whose subsistence we know not where so finde; as honor, praise, glory, command, singularity, eminency, shame, infamy, subjection, reproach, and the like: unto any of which, none of our senses can reach; and yet they govern mans life, in a manner wholly and perfectly.

In *negotiation*, we propose to single men their own interests and profits; not such as the proposer can, or will effect; but

such as are likely to arise out of the action we endeavour to draw him unto with whom we treat. In both these, the usual labour is, to make our neighbours willing to leave some present good, in hope of a greater to come; or to be content to undergo some present harm, for fear of a greater to ensue. The general instrument which they use, is *discourſing*; whose vertue consisteth partly in our own minde, and partly in delivering our minde to others: for first we must know what we should say, and next in what manner we should say it.

6. Of Logick. The art which directeth our own minde, and teacheth us what to say, is *Logick*: whose parts are two; according as the affairs falling into discourse, are likewise of a twofold nature: the one instructeth us how to manage and order our reason, when it dealeth with such subjects as we may attain to certainty in. And here the rules of *Demonstration* take place; teaching us to define, to divide, and to conclude. The other instructeth us how to behave our selves, when we meet with such subjects, as a good and probable guesse is the farthest we can reach unto towards the knowledge of them: and for these, the *Topical* part of Logick serveth; the which, taking a view of all the accidents belonging to any thing propounded, sheweth how to draw probabilities from every one of them.

7. Of Grammar. Our discourſing to others, is either to open our mindes barely unto them; or to perswade them of somwhat our selves believe; or to winne them to somwhat we would have them do. For the bare delivery of our mindes to others, we have *Grammar*; the scope of which art, consisteth first, in teaching us to deliver our conceptions plainly and clearly, (which is the main intent of speaking) next in making, our discourse be succinct and brief, (which is the measure of our speaking, both for our selves and others;) and lastly, in sorting our words, so as what we say, may be accompanied with sweetnesse; both in common, in regard of the ear, by avoyding such harsh sounds as may offend it; and in particular, in regard of the custom of the language wherein we speak, and of the persons to whom we speak.

8. Of Rhetorick. The art whereby we may perswade others, and winne them to assent unto what we would have them, is *Rhetorick*. Her rules instruct us how to dispose and order with best advantage, in regard of

of the Auditours diſpoſition, both the reaſons which *Logick* affordeth us, and the words which *Grammar* ſtoreth us with: as alſo, how to give life and motion to what we ſay, by our action and geſture; that ſo we may perſwade our Auditory, ſuch paſſions reign in us, as we ſeek to ſtir up in them: for as we may obſerve, that one who yawneth, maketh another likewiſe yawn; and as our ſeeing others laugh, provoketh laughing alſo in us (the reaſons whereof we have touched in the former Treatiſe;) after the ſame manner, what paſſion ſoever we exhibite in our ſelves, the ſame ſtealeth inſenſibly upon thoſe we ſpeak unto; whiles their minde attending to the words they hear, is not aware of the ſubtile ſpirits motions, that by a kind of contagion riſe and ſwell in their hearts: according to which natural inclination in all men, the Maſter of Poets, and excellent obſerver of mens humours ſaid paſſing well:

Si vis me flere, dolendum eſt
Primùm ipſi tibi.

Hence grow thoſe encreaſes by metaphors, hyperboles, and other tropes and figures: hence thoſe fervors by interrogations, exclamations, apoſtrophes, and the like; which when they are fitly placed, they carry the Auditour even againſt his will.

9. Of Poetry.

Poetry, is not a governour of our Actions, but by advantagious expreſſing ſome eminent ones, it becometh an uſeful directour to us; and therefore challengeth a place here. The deſign of it is, by repreſenting humane actions in a more auguſt and admirable hew, then in themſelves they uſually have: to fram ſpecious Ideas, in which the people may ſee, what is well done, what amiſſe, what ſhould be done, and what by errour is wont to be done: and to imprint in mens mindes a deep conceit of the goods and evils, that follow their vertuous or vitious comportment in their lives.

If thoſe who aſſume the title of *Poets*, did aim at this end, and would hold themſelves ſtrictly to it, they would prove as profitable inſtruments as any the commonwealth had: for the delightfulneſs and blithneſs of their compoſitions, invitch moſt men to be frequently converſant with them; (either in ſongs, or upon the Stage, or in other Poems) whiles the ſober aſpect and ſeverity of bare precepts, deturneth many from lending a pleaſed

ear to their wholesome doctrine; and what men swallow with delight, is converted into punishment: so that, if their drift were to settle in mens mindes a due valuation of vertue, and a detestation of vice, no art would do it more universally, nor more effectually: and by it, mens hearts would be set on fire to the pursuit of the one, and be shrunk up with dislike and horrour against the other. But unto such a Poet as would aim at those noble effects, no knowledge of *Morality*, nor the nature and course of humane actions and accidents must be wanting: he must be well versed in *History*; he must be acquainted with the progresse of nature, in what she bringeth to passe; he must be deficient in no part of *Logick*, *Rhetorick*, or *Grammar*: in a word, he must be consummate in all Arts and Sciences, if he will be excellent in his way.

10. Of the power of speaking.

But whiles we thus entertain our selves with those Arts, which serve us in discourfing with others, it were a great overfight to forget that faculty, which is the *basis* and ground-work of all those: and that is, the power of speech, which nature hath bestowed upon us. It consisteth in two actions: the one outward, the other inward: the outward, is the giving of various sounds to our breath, as it passeth through our mouth, by divers conjunctions of our tongue, teeth, and lips, to themselves, or to divers parts of our mouth, or by their separations from them: in which, we see that birds are able to imitate us, and I am perswaded, the like might be effected by insensible creatures; if a dexterous man would employ his time, in contriving and making an instrument to expresse those different sounds; which, nor having more than seven substantial differences besides the vowels (as some who have carefully noted them, do affirm) it would peradventure be no hard matter to compose such an engine.

The inward action of location, is the framing of convenient answers to what is asked; of fit replies to what is said; and in a word, to speak appositely, and to the purpose: whereunto, neither beast nor dead instrument can be brought, unless the artificier be able to endue it with understanding.

11. Of arts that concern dumb and insensible creature.

All other Arts, instruct us how to work orderly upon beasts and insensible bodies: by some of them, we cultivate living creatures, as when husband-men nourish sheep, oxen, soul, and the like, for slaughter: by others, we discipline them, as when we teach

teach horſes, dogs, apes, hawks, parrats, and ſome kinde of fiſhes, to hunt, to play, and in a word, to do ſomewhat either for our profit, or for our pleaſure: and again, by others we uſe their natures to our ends; as when we lay baits to catch them, when when we ſet egges under hens, to have the chickens, and the like: by other arts, we work as powerfully upon inſenſible creatures; among which, by knowing the natures of divers trees, herbs, minerals, &c. we are able to bring any of them to what uſe ſoever we finde moſt expedient for our ſervice: from hence grow all thoſe Arts and Trades, in which we ſee men daily ſpend their whole lives; ſo as it is needleſſe to inſiſt upon the particulars of them, ſince Townes and the Cities are compoſed of the ſeveral Tribes of perſons that profeſſe them and live by them.

But we muſt not leave this ſubject, without noting how admirably mans wit turneth it ſelfe to ſo different ſorts, and to ſuch an infinite variety of things. For what man is there, (if he be a man) but might have become Maſter in any of theſe ſo differing Trades, in caſe he had applyed himſelf as conſtantly to that, as he hath done to ſome other he is perfect in? Again, let us conſider how it happeneth often, that he doth not the ſame thing twice the ſame way, but according to his own, or another mans fanſie, changeth his work at will, now doing it after one faſhion, now after another; as having no law or determination from Nature, but being wholly left to his own direction.

There remaineth one art, not yet ſpoken of; which knoweth not where to challenge a place, whether among the moderatours of our own actions, or among thoſe whereby we govern things: and that is *Arithmetick*: which ſeemeth to belong unto things, and yet it medleth not with them: and again, it ſeemeth to be a main directour of our internall actions, and yet belongeth neither to *Morals*, nor to *Logick*. Whereſoever its due be to place it, I am ſure its not to be forgotten; ſeeing it is ſo principal an one, as our life can hardly conſiſt without it. It worketh upon notions that are no where; for every thing that is in the world, is but one; and to be, or to make a number, cannot happen without an underſtanding: the affections likewiſe of them, are as the ſubject, all inviſible; as to be even or odde, to be cubes, ſquares, roots, &c. and yet how great the power and extent of this 12. Of Arithmetick.

art is, none can rightly understand or believe, but he that hath the knowledge of it, or hath seen the vertue and efficacity of it.

13. Of Prudence. All these arts, consist in common rules, which require the second of those qualities, whereby we said humane actions are governed, to apply them to their particular matter: and that is *Prudence*; which we may define to be, a quality or power, by whose assistance we apply unto the matter we are to work upon, such instruments, as in our present judgement appear fittest to bring it to that passe, which serveth best for our intentions, when by our senses, or by other guesses, we know the particular dispositions of the matter, and of the instruments wherewith we are to change it. Now howbeit this occurreth generally in all arts, yet its special place and necessity, is in governing and moderating our own or other mens *Morall* actions; and accordingly, its name is especially addicted thereunto: and that man is said to be prudent or discreet, who governeth himself and others well.

This quality of *Morall Prudence* in generall, is divided into three particular ones: the first of which belongeth to a governour in a State or Commonwealth: the next may be assigned to him that is skilful in the laws: and the third concerneth the managing and conduct of military actions. The reason of this long received distribution peradventure is, because in these occurrences, our passion swayeth us generally more then in any others: and the operation and effect of *Prudence*, (whose Province is to curbe and moderate our passions by reason) is greatest, and appeareth most in those subjects, where passion reigneth usually with greatest impetuosity.

14. Observations upon what hath been said in this Chapter. Thus have we runne over the main parts of discourse, and the general heads of mans action as man: which peradventure may through their numerousnesse, appear to be as it were but loosely scattered from our pen; (as happeneth unto all materials, that must serve for after buildings; and that till they be employed, require no more but sorting, and laying together in several heaps, to the end they may be ready for use:) and therefore before we go any farther, it will not be amisse to make reflexions upon what we have said; and to draw it neerer our intended scope; and to square out and give some figure and polishing

poliſhing to theſe ſtones, here where we digge them out of the quarry, whereby they may hereafter with leſſe adoe, fit the places we have aſſigned them, in the ſtructure we intend: and ſo, a little trouble here, whiles our tools are ſtill in our hands, and our matter lyeth ready for our ſtroaks, and our thoughts are warm with working upon them, may ſave us a great deal there, where our main imployment will be, to lay artificially; and to joyn cloſely, what now we but hew out: and therefore will require finer inſtruments, and a ſharper edge, than what at preſent ſerveth our turn.

Let us then bring back to account all we have ſaid in this Chapter: and when we have well reflected upon every particular, we ſhall finde they all agree in this, that they are nothing elſe but a due ordering of one thing with another: a ſyllogiſm is an ordering of ſome few notions: a Science is an ordering of ſyllogiſms, in ſuch ſort, as a new Propoſition may follow out of thoſe which went before: and as we ſee that when by our thoughts divers ſyllogiſms are well ordered, hidden things come to be diſcloſed in our underſtanding; even ſo among bodies, if things whoſe proprieties are known, be likewiſe ordered and put together, thoſe very effects, which were diſcovered by the ordering of notions in our head, will ſpring forth in nature: as for example, if by knowing the natures of fire and of towe, our diſcourſe findeth that towe put to fire will preſently become fire, the ſame will happen in nature, if we put material towe, or ſome other body that hath the qualities of it, to real fire, or to ſome other ſubſtance that is endewed with the vertues of fire: in like manner, if by knowing that colours are nothing elſe, but various mixtures of light and of darkneſſe in bodies, our diſcourſe aſſureth us, that by ſeverall compoundings of theſe extremes, red, blewes, yellowes, greenes, and all other intermediate colours may be generated; accordingly we ſhall finde in effect, that by the ſeverall minglings of black and white bodies (becauſe they reflect or drown light moſt powerfully) or by interweaving ſtreames of pure light and of ſhadowes one with another, we may procreate new colours in bodies, and beget new luminous appearances to our eyes: ſo that hence it appeareth clearly, that the ſame nature is in our underſtanding, and in the things: and that the ſame ordering, which in

the one maketh Science, in the other cauſeth natural tranſmutations.

Another reflexion, which will be fit for us to make upon theſe long diſcourſes, is this, that of neceſſity there muſt be a joyning of ſome things now actually in our knowledge, unto other things we think not of: for it is manifeſt, that we cannot at the ſame time actually think of a whole book of *Euclide*, and yet to the due knowledge of ſome of the laſt Propoſitions, the knowledge of almoſt all the former is required: likewiſe it is impoſſible we ſhould at the ſame time think of all the multitude of rules belonging to any art, as of Grammar, of Metering, of Architecture; and yet when we write in Latine, make a Poem, or lay the deſign of a houſe, we practiſe them whiles we think not of them, and are aſſured we go not againſt them, however we remember them not.

Nay, even before we know a thing, we ſeem to know it; for ſince we can have a deſire of nothing, but of what we know, how could we deſire to know ſuch or ſuch a thing, unleſſe we know both it, and the knowledge of it? And for the moſt part we ſee a horſe, or man, or herb, or workmanſhip, and by our ſenſe have knowledge that ſuch a thing is is, before we know what, or who, or how, it is: that groweth afterwards out of the diligent obſervation of what we ſee: which is that, whereby learned men differ from the unlearned, for what ſtriketh the ſenſe, is known alike by them both; but then here is the difference between them, the latter ſort ſitteth ſtill with thoſe notions, that are made at the firſt, by the beating of our ſenſe upon us, without driving them any farther: and thoſe that are learned, do reſolve ſuch compounded notions, into others made by more common beatings, and therefore more ſimple: and this is all the oddes in regard of knowledge, that a Scholar hath of an unlettered man.

One obſervation more we will draw out of what we have ſaid, and then end this Chapter: it is, how a man doth oftentimes enquire among his own thoughts, and turneth up and down the images he hath in his head, and beateth his brains, to call ſuch things into his minde, as are uſeful unto him, and are for the preſent out of his memory: which, as we ſee it ſo neceſſary, that without it no matter of importance can be performed in the way

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of diſcourſe (whereof I my ſelf have too frequent experience in the writing of this Treatiſe) ſo on the other ſide, we cannot perceive that any creature beſides Man, doth it of ſet purpoſe and formally as Man doth.

THE FROUTH CHAPTER.

How a man proceedeth to Action.

HAving thus taken a ſummary view of the principal Qualities a man is enduced withal, *Apprehending Judging*, and *Diſcourſing*; and having ſhewed how he is inriched in and by them with the natures of all things in the world; it remaineth for our laſt work in this part, to conſider in what manner he maketh uſe of this treaſure in his ordinary actions: which it is evident are of two different kindes, and conſequently have two ſeveral principles, Underſtanding and Senſe, they ſway by turns, and ſometimes joyn together, to produce a mixed action of both. 1. That humane actions proceed from two ſeverral principles, Underſtanding and Senſe.

If onely Senſe were the fountain from whence his actions ſpring, we ſhould obſerve no other ſtrain in any of them, then meerly that according to which Beaſts perform theirs: they would proceed evermore in a conſtant unvariable tenour, according to the law of material things, one body working upon another, in ſuch ſort as we have declared in the former Treatiſe.

On the other ſide, if a man were all underſtanding, and had not this bright lamp encloſed in a pitcher of clay, the beams of it would ſhin without any allay of dimneſſe, thorough all he did; and he could do nothing contrary to reaſon, in purſuit of the higheſt end he hath prefixed unto himſelf; for he neither would, nor could do any thing whatſoever, untill he had firſt conſidered all the particular circumſtances, that had relation to his action in hand; and had then concluded, that upon the whole matter, at this time, and in this place, to attain this end, it is fitting and beſt to do thus or thus: which concluſion could be no ſooner made, but that the action would without any further diſpoſition on his ſide, immediately enſue, agreeable to the prin-

principles it ſpringeth from. Both parts of this aſſertion are manifeſt: for the firſt, it is evident, that whenſoever an Agent worketh by knowledge, he is unreſolved whether he ſhall work or not work, as alſo of his manner of working, until his knowledge (that ought to direct and govern his working) be perfect and compleat: but that cannot be, as long as any circumſtance not as yet conſidered, may make it ſeem fit or unfit to proceed: and therefore, ſuch actions as are done without exact conſideration of every particular circumſtance, do not flow from a pure underſtanding. From whence it followeth, that when an underſtanding is not ſatisfied of every particular circumſtance, and conſequently cannot determine what he muſt immediately do, but apprehendeth that ſome of the circumſtances not as yet conſidered, may (or rather muſt) change ſome part of his action, it muſt of neceſſity be undermined in reſpect of the immediate action; and conſequently, it muſt refraine abſolutely from working. The other part is clear; to wit, that when the underſtanding, upon conſideration of all circumſtances, knoweth abſolutely what is beſt, the action followeth immediately (as farre as dependeth of the underſtanding) without any farther diſpoſition on his behalf: for ſeeing that nothing but knowledge belongeth to the underſtanding, he who ſuppoſeth all knowledge in it, alloweth all that is requiſite or poſſible for it to work by: Now if all be put, nothing is wanting that ſhould cauſe it to work: but where no cauſe is wanting, but all requiſite cauſes are actually being, the effect muſt alſo actually be, and follow immediately out of them: and conſequently, the action is done, (in as much as concerneth the underſtanding, and indeed abſolutely, unleſſe ſome other cauſe do fail) as ſoon as the underſtanding knoweth all the circumſtances belonging to it: ſo as it is manifeſt out of this whole diſcourſe, that if a man wrought onely by his underſtanding, all his actions would be diſcreet and rational, in reſpect of the end he hath propoſed to himſelf; and till he were aſſured what were beſt, he would keep himſelf in ſuſpenſe and do nothing; and as ſoon as he were ſo, he would admit of no delaies, but would at the inſtant proceed to action according to his knowledge: the contrary of all which, we daily ſee by experience in every man.

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We may then safely conclude, that in humane nature there are two different centers, from whence crosse actions do flow: the one he hath common with beasts, and whose principles and laws we delievered in the former Treatise, where we discoursed of life, and the motions of life and of passions: the other is the subject of our present enquiry; which in this place, expecteth at our hands, that we should consider how it demeaneth it self, and what it doth in us, when by its guidance we proceed to any action. Experience must be our informer in general: after which, our discourse shall anatomise what that presenteth us in bulk. She giveth us notice of three especiall effects of our understanding: first, that it ordereth aright those conceptions which are brought unto it; secondly, that when they appear to be not sufficient for the intended work, it casteth about and seeketh out others: and thirdly, that it strengthneth those actions which spring from it; and keepeth them regular and firm and constant to their beginnings and principles. Unto which last seemeth to belong, that it sometimes cheeketh its own thoughts, and bringeth back those it would have, and appeareth to keep as it were a watch over its own waies. 2. How our general and inbred maximes do concur to humane action.

As for the ordering of the present notions, it is clear that it is done by a secret dependance from the rules of discourse, and from the maximes of humane action: I call this dependance a secret one, because a man in his ordinary course, maketh use of those rules and *maximes* which serve his turn, as though they were instilled into him by Nature, without so much as ever thinking of them, or reflecting upon them to square out his actions by them: nay, some of them so far out of the reach of most men, as they cannot think of them, though they would; for they know them not: as in particular, the rules of discourse; the use of which is so necessary, as without it no man can converse with another, nor do any thing like a man, that is, reasonably. From whence then can this proceed, that so familiarly & readily a man maketh use of what he is not conscious to himself that he hath any acquaintance withal? It can be nothing else, but that the soul, being in her own nature ordered to do the same thing, which Scholars with much difficulty arrive to know what it is by reflection and study, and then frame rules of that afterwards carry their discourse to a higher pitch, she by an inborn vertue maketh

maketh a man do it orderly, constantly, and certainly.

3. That the rules and maximes of arts do work positively in us though we think not of them.

The like may be observed in the daily use men make of the *maximes* of humane action: which are certain knowledges that formerly they have gotten, but that they usually think not of, whiles they work agreeable to them; yet it seemeth they work by them; for if their action should jarre against any of them, they would presently reflect upon their *Maxime*, and by it correct what they were about: for example, one who is skilled in the rules of *Grammar*, or of accenting his speech, or hath his ear used to *Musick*, whiles he heareth true construction, or even verse, or consonant song, never reflecteth how it is made; or at most doth but consider in grosse that it is right: but if a solecism, or false quantity, or discord intervene, he presently is aware, not onely that it is amisse, but remembreth the very particular precise rule against which the breach is made.

This at the first sight might occasion us to imagine, that the rules by which any composition is made, do work onely negatively in us, whiles we are busie about it: that is, that they contribute nothing to the making of the thing, but onely hinder us from committing errours: but if we consider the matter well, we shall finde it impossible, but that they should work even positively in us; for we know that when we first learn any of these things, we look industriously for such a gender, or number, or case, or tense, for such a foot or quantity, such a note, or consonance; and we are sure, that use and practise of the same thing, doth not change, but onely facilitate the work: therefore it followeth of necessity, that we still use those very instructions, by which at the first we could but slowly creep, but now manage them with such celerity, as our fansie cannot keep pace with what we do. And this is the reason why we do not perceive that we think of them, but may peradventure at the same time think of a quite different matter; as when a Musician playeth voluntary division upon a ground he never saw before, and yet hath all the while some other thought in his head; or when a Painter draweth a picture, and all the while discourseth with a by-stander.

This truth may be convinced by another argument: as thus; it cannot be doubted, but that a verse or song is made by the *power* of making such compositions: but that *power* is the art of them; and that art is nothing else but the rules whereby they are made:

made: and accordingly we ſee, that who hath not the art, cannot make ſuch compoſitions: but who hath, can when he pleaſeth: and if any man would be able to make them, he preſently ſtudyeth the art: ſo that it cannot be doubted, but that artificial things are alwaies made by the uſe of thoſe rules which teach the making of them; although for the moſt part we are not able to perceive how ſuch rules are uſed: and beſides this, we are ſure that we do not onely make uſe of thoſe rules we learned at the firſt, but when we are arrived to Maiſtery in any art, we make uſe of them in a quite different manner then we did in the beginning, and then we do in any other thing, wherein we finde pain and difficulty.

4. How the underſtanding doth caſt about when it wanteth ſufficient grounds for action.

In the ſecond effect that we experience of our underſtanding, (which is, our caſting about for new conceptions, when thoſe it already hath, appear not ſufficient to direct what it hath in hand) the force and working of it, is very evident: for this effect proceedeth out of a want of ſatisfaction: and this belongeth properly to the underſtanding; for if evidence and ſatisfaction be qualities of it, then of neceſſity the privation of theſe qualities, muſt likewiſe belong unto it: as alſo to diſcern that privation, and to uſe means to avoid it: and in the very caſting about, we ſee a choice made: and that things are not taken promiſcuouſly as they come of a row, but that ſome of them are ſet aſide, and others advanced for uſe: which argueth plainly the knowledge and government of the underſtanding.

5. How reaſon doth rule over ſenſe and paſſion.

But the third operation, is that which giveth cleareſt evidence of the peculiar and diſtinct working of the underſtanding: for if we mark the conteſtation and ſtrif within us, between our ſenſual part and his antagoniſt which maintaineth the reſolution ſet by reaſon, & obſerve how exceedingly their courſes and proceedings differ from one another; we ſhall more plainly diſcern the nature, and power, and efficacy of both of them. We may perceive that the motions againſt *Reaſon*, riſe up turbulently, as it were in billows, and like a hill of boyling water (as truly *Paſſion* is a conglobation of ſpirits) do put us into an unquiet and diſtempered heat and confuſion: on the other ſide, *Reaſon* endeavoureth to keep us in our due temper, by ſometimes commanding down this growing ſea; otherwhiles, by contenting in ſome meaſure the deſires of it, and ſo diverting another

way

way its unruly force: sometimes she terrifieth it, by the propoſal of offensive things joyned unto those it is so earnest to enjoy: Again, sometimes she preventeth it, by cutting off all the causes and helps that promote on its impotent desires, and by engaging before hand the power of it in other things, and the like.

All which do evidently convince, that as *Reason* hath a great strength and power in opposition of sense, so it must be a quite different thing, and of a contrary nature unto it: we may adde, that the work of *Reason* can never be well performed, but in a great quiet and tranquillity; whereas the motions of *Passion*, are alwaies accompanyed with disorder and perturbation: so as it appeareth manifestly that the force of *Reason*, is not purely the force of its instruments, but the force of its instruments as they are guided. and as the quantities of them are proportioned by it: and this force of *Reason*, is different from the force of its instruments in themselves, in such sort as the force of a song, is different from the force of the same sounds, whereof it is composed, taken without that order which the Musician putteth in them: for otherwise the more spirits that are raised by any thought (which spirits are the instruments whereby *Reason* performeth all her operations in us) the more strongly *Reason* should work; the contrary of which is evident, for we see that too great abundance of spirits confounds *Reason*.

How we recal our thoughts from distractions.

6. This is as much as at present I intend to insist upon, for proof that our understanding hath its proper & distinct operations, and worketh in a peculiar manner, & in a quite different strain from all that is done by our senses. Peradventure some may conceive, that the watchfulness and recalling of our thoughts back to their enjoyned work, when they breake loose and run astray, and our not letting them range abroad at random, doth also convince this assertion: but I confesse ingeniously, the testimony of it seemeth not clear to me; and therefore I rank it not with those, that I would have (if it may be) solidly weighty, and undenyable to who shall consider maturely the bottom and full efficaciousness of them. Of such, a few, or any one, is enough to settle ones minde in the belief of a truth: and I hope, that this which we have laboured for in this Chapter, is so sufficiently proved, as we need not make up our evidence with number of testimonies.

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But to shew the exception I take against this argument, let us examine, how this act within us which we call watchfulnesse, is performed: truly, me thinketh it appeareth to be nothing else, but the promptitude and recourse of some spirits, that are proper for this effect, which by a mans earnestnes in his resolution, do take a strong impression, and so are still ready to knock frequently at the door of our understanding, and thereby enable it with power to recall our strayed thoughts. Nay, the very reflexion it self, which we make upon our thoughts, seeme h unto me to be only this, that the object beating upon the fansie, carryeth back with it at its retyring from thence, some little particle or atome of the brain or *Septum Lucidum*, against which it beateth, sticking upon it; in like manner as upon another occasion, we instanced in a ball rebounding from a green mudde wall, unto which some of the matter of the wall must needs adhere: now this object, together with the addition it getteth by its stroak upon the fansie, rebounding thence, and having no more to do there at present, betaketh it self to rest quietly in some cell it is disposed into in the brain, as we have delivered at large in our former Treatise, where we discoursed of *Memory*: but whensoever it is called for again by the fansie, or upon any other occasion returneth thither, it commeth as it were capped with this additional piece it acquired formerly in the fansie; and so maketh a representation of its own having been formerly there.

Yet, be these actions performed how they will, it cannot be denyed, but that both of them are such, as are not fit, nor would be any waies usefull to creatures, that have not the power of ordering their own thoughes and fansies, but are governed throughout meerly by an uniform course of nature: which ordering of thoughes, being an operation feasible onely by rational creatures, and by none others, these two actions (which would be in vain, where such ordering is not used) seem to be specially ordained by Nature, for the service of *Reason* and of the *Understanding*; although peradventure a precise proper working of the understanding, do not cleerly shine in it. Much lesse can we by experience finde among all the actions we have hitherto spoken of, that our *Reason* or *Understanding* worketh singly and alone by it self, without the assistance and consortship of the

the fantaſie: and as little can I tell how to go about to ſeek any experience of it.

7. How reaſon is ſometimes overcome by ſenſe and paſſion.

But what *Reaſon* may do in this particular, we ſhall hereafter enquire: and end this Chapter, with collecting out of what is ſaid, how it fareth with us, when we do any thing againſt *Reaſon*, or againſt our own knowledge. If this happen by ſurpriſe, it is plain that the watch of *Reaſon* was not ſo ſtrong as it ſhould have been, to prevent the admittance or continuance of thoſe thoughts, which work that tranſgreſſion. Again, if it be occaſioned by *Paſſion*, it is evident that in this caſe, the multitude and violence of thoſe ſpirits which *Paſſion* ſendeth boyling up to the fantaſie, is ſo great, as the other ſpirits, which are in the jvriſdiction and government of *Reaſon*, are not able for the preſent to ballance them and ſtay their impetuoſity, whiles ſhe maketh truth appear. Sometimes we may obſerve, that *Reaſon* hath warning enough, to muſter together all her forces, to encounter, as it were in ſet battail, the aſſault of ſome concupiſcence, that ſendeth his unruly bands to take poſſeſſion of the fanſie, and conſtrain it to ſerve their deſires, and by it to bring *Reaſon* to their bent. Now if in this pitched field ſhe looſe the bridle, and be carryed away againſt her own reſolutions, and be forced like a captive to obey the others laws, it is clear that her ſtrength was not ſo great as the contrary factions.

The cauſe of which is evident; for we know that ſhe can do nothing, but by the aſſiſtance of the ſpirits which inhabit the braine: now then it followeth, that if ſhe have not the command of thoſe ſpirits which flock thither, ſhe muſt of neceſſity be carryed along by the ſtream of the greater and ſtronger multitude; which in our caſe, is the throng of thoſe that are ſent up into the brain by the deſired object; and they come thither ſo thick and ſo forcibly, that they diſplace the others which fought under *Reaſons* Standard: which if they do totally, and excluding Reaſons party, do entirely poſſeſſe the fanſie with their troops, (as in madneſſe and in extremity of ſudden paſſion it happeneth) then muſt *Reaſon* wholly follow their ſway, without any ſtrugling at all againſt it; for whatſoever beateth on the fanſie, occaſioneth her to work; and therefore when nothing beateth there but the meſſengers of ſome ſenſual object, ſhe can

make

make no resistance to what they impose: but if it happen that these tumultuary ones, be not the onely spirits which beat there, but that *Reason* hath likewise some under her jurisdiction, which keep possession for her, though they be too weak to turn the others out of doors; then it is true, she can still direct fairly, how in that case a man should govern himself; but when he cometh to execute, he findeth his sinews already possessed, and swelled with the contrary spirits; and they keeping out the smaller and weaker number, which reason hath ranked in order, and would furnish those parts withal, he is drawn even against his judgement and *Reason*, to obey their appetites, and to move himself in prosecution of what they propose; in such sort as the Poet expresseth that *Medea* found in her self, when she complained and bemoaned her self in these words, *Video meliora proboque, Deteriora sequor*: and in this case, a man foreseeth his misery all the way he rouleth towards it, and leapeth into the precipice with his eyes open: which sheweth that the army of thoughts on *Reasons* side, should be encreased in number, to have her strong enough to wage battel with the rebellious adversary: or else, that her adversary should be so much weakened, that she, though not grown stronger in her self, yet might, through the others enfeebling, be able to make her party good; (and hence is the use of corporeal mortifications, to subject our *Passions* to the behest of *Reason*) even as when we see, that when we are in health, our arms, and legs, and all our limbs, obey our will, reaching what we command them, and carrying us whither we desire, because the spirits which are sent into them from our brain, are strong enough to raise and move them as they are directed; but if our sinews be so steeped in some cold and watry humour, that the spirits coming down, find not means to swell and harden them; well we may wish and strive, but all in vain: for we shall not be able to make them perform their due functions. In like manner, if *reason* do send her emissaries into the same arm or leg, or other member, and no other spirits do there strive against them, then that limb is moved and governed absolutely according to her directions: but if at the same time, a greater multitude of others, do hinder *reasons* servants from coming thither, or flocking into other sinews, do carry that limb a contrary way; in vain doth *reason* strive to move them to her byas; for those obeying parts must observe the rules which the violent conqueror prescribeth.

THE FIFTH CHAPTER.

Containing proofs out of our ſingular apprehenſions, that our ſoul is incorporeal.

1. The connection of the ſubſequent Chapters with the precedent.

AS in our firſt Treatiſe we diſſected nature, and ſhewed, how out of the notion and firſt diviſion of Quantity, ariſeth that vaſt multiplicity of things, which filling this world, falleth under the conſideration of our ſenſes: ſo in the beginning of this ſecond Treatiſe, we have ſearched into thoſe operations of a man (attributed to his ſoul) by which he is conceived to excell all other living creatures: and there diſcovered, that the admirable and unlimited variety of works, which is ſeen in mens writings and actions, doth all flow from the ſource of *ſingle apprehenſions*; and even from one bare notion of *Being*: which is the root and principle, from whence all others derive their originē; and into which all may be reſolved; works proceeding from reſolution, they from diſcourſe, theſe being compoſed of judgements, and judgements of ſingle apprehenſions. This part we muſt now review, and enquire what we can finde in mans operation, arguing the *quality* of his ſoul; whether it be corporeal or no. For if theſe ſingle apprehenſions, and the proceſſes compounded of them, may be performed by the ordering of rare and denſe parts (as the other works of nature are) then they will be corporeal, and of the ſame kinde with thoſe, which we opened in the firſt Treatiſe: but if we ſhall prove, that they cannot poſſibly be deduced from multiplicity, and order of quantitative parts, when we may confidently reſolve our ſelves, that in the cauſe from which they flow, is a nature wholly diſcrepant from that which reſideth among bodies, and among corporeal things.

This we ſhall here labour to do: and to that end, we will begin our work with reflecting upon what we have delivered of a ſingle apprehenſion, in the firſt Chapter of this ſecond Treatiſe: whoſe nature we there firſt explicated in common; and thence proceeded to ſome particular apprehenſions; and laſtly, ſhewed the extent they comprehended. Theſe then muſt be the ſubject of our preſent ſpeculation.

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As for their nature, we may remember, how we resolved three things: first, that by apprehension, the very thing apprehended is by it self in our soul: next, that the notion of *being*, is the first of all notions, and is resumed in all others: and thirdly, that what is added to the notion of *being*, is but *respects* to other things. Now then let us consider, what kinde of Engines they must be, that may have the power to make things themselves to be in our soul, if they were to be there materially? How shall the place, or the time past, be removed, and be put in another place, and in another time? How shall the quantity of the heavens, of the whole world, nay of bigness exceeding all that by millions of proportional encreases, be shut up in the little circuit of mans brain? And if we examine our selves strictly, we shall finde nothing wanting; all is there. How shall the same thing be corporally in two, nay in two thousand places, at the same time? And yet, in so many is the Sun, when two thousand men think of it at once. We must then allow, that things are there immaterially; and consequently, that what receiveth them, is immaterial: since every thing is received according to the measure and nature of what receiveth it.

2. The inexistence of corporeal things in the soul, by the power of apprehension, doth prove her to be immaterial.

But I easily conceive, that the strangeness and incredibility of our Position, may counterballance the force of it: for who can perswade himself, that the very thing he apprehendeth, is in his minde? I acknowledge, that if its being there were to be understood corporally, it were impossible: but on the other side who shall consider, that he knoweth the thing he rightly apprehendeth, that it worketh in him, and maketh him work agreeable to its nature, and that all the properties and singularities of it may be displayed by what is in him, and are as it were unfolded in his minde, he can neither deny nor doubt, but that it is there in an admirable and spiritual manner. If you ask me how this cometh to pass? And by what Artifice, Bodies are thus spiritualized? I confess I shall not be able to satisfie you: but must answer, that it is done, I know not how, by the power of the soul: shew me a soul, and I will tell you how it worketh: but as we are sure there is a soul, (that is to say, a *Principle* from whence these operations spring) though we cannot see it: so we may, and do certainly know, that this mystery is as we say; though because we understand not the true and compleat na-

nature of a ſoul, we can as little expreſs the manner, how it is done by a ſoul. Yet, before we take our leave of this matter of *Apprehenſions*, we will in due place endeavour to ſay ſomething towards the clearing of this obſcure point.

3. The notion of *being*, which is innate in the ſoule, doth prove the ſame.

Our ſecond conſideration upon the nature of *apprehenſion*, was, that our primary and main notion, is of *being*. This diſcovereth ſome little glympſe of the nature of the ſoul: for it is manifeſt that ſhe applieth this notion, as well to no parts, as to parts: which we proved in the firſt Treatiſe, when we ſhewed that we have a particular notion of *ſubſtance*, diſtinct from the notion of *quantity*; for quantity and parts being the ſame, it followeth that if there be a notion ſuppoſed by quantity, (as in ſubſtance there is) it muſt of neceſſity abſtract from parts: and conſequently, we may conclude, that the notion of *being*, which is indifferently appliable either to quantity or to ſubſtance, doth of its own nature wholly abſtract either from *Parts*, or from no *Parts*. I then infer: that ſince this notion of *being*, is the very firſt and virgin notion our ſoul is imbued with, or is capable of, and that it is the root of all other notions, and into which ſhe reſolveth every other notion, in ſuch ſort, as when we have ſifted and ſearſed the eſſence of any notion whatſoever, we can diſcover nothing that is deeper than this, or precedent to it, and that it agreeth ſo compleatly with our ſoul, as ſhe ſeemeth to be nothing elſe but *a capacity fitted to Being*, it cannot be denied, but that our ſoul muſt needs have a very neer affinity and reſemblance of nature with it: but it is evident, that *Being* hath not of it ſelf any parts in it, nor of it ſelf is capable of diviſion: and therefore it is as evident, that the ſoul which is framed (as it were) by that pattern and Idea, and is fitted for *Being* as for its end, muſt alſo of it ſelf be void of parts, and be incapable of diviſion. For how can parts be fitted to an indiviſible thing? And how can two ſuch different natures ever meet proportionably?

If it be objected, that the very notion of *Being*, from whence we eſtimate the nature of the ſoul, is accommodable to parts: as for example, we ſee that ſubſtance is endued with quantity: We anſwer, that even this doth corroborate our proof: for ſeeing that the ſubſtances, which our ſenſes are acquainted with all, have parts, and cannot be without parts; and yet nevertheleſs

leſs in our ſoul, the notion of ſuch ſubſtance is found without parts; it is clear, that ſuch ſubſtance hath this meerly from our ſoul: and becauſe it hath this indiviſibility from our ſoul, it followeth that our ſoul hath a power and nature to beſtow indiviſibility upon what cometh into her. And ſince it cannot be denied, but that if any ſubſtance were once exiſtent without parts, it could never after have parts; it is evident, that the nature of the ſoul is incapable of parts, becauſe it is exiſtent without parts. And that it is in ſuch ſort exiſtent, is clear: for this effect of the ſouls giving indiviſibility unto what ſhe receiveth unto her, proceedeth from her as ſhe is exiſtent. Now ſince this notion of *being*, is of all others the firſt and Original notion that is in the ſoul, it muſt needs above all others, favour moſt of the proper and genuine nature of the ſoul: in which, and by which, it is what it is, and hath its indiviſibility.

If then it be preſſed; how can ſubſtance (in reality or in things) be accommodated unto Quantity, ſeeing that of its ſelf it is indiviſible? We anſwer, That ſuch ſubſtance, as is the ſubject of *quantity*, and that hath *quantity*, is not indiviſible; for ſuch ſubſtance cannot be ſubſiſtent without *quantity*; and when we frame a notion of it, as being *indiviſible*; is it an effect of the force of our ſoul, that is able to draw a notion out of a thing that hath parts, without drawing the notion of the parts: which ſheweth manifeſtly, that in her there is a power above having of parts: which being in her, argueth her exiſtence to be ſuch.

4. The ſame is proved by the notion of *reſpects*.

Our laſt conſideration upon the nature of apprehenſion, was, how all that is added to the notion of *being*, is nothing elſe but *reſpects* of one thing to another; and how by theſe *reſpects*, all the things of the world come to be in our ſoul. The evidence we may draw from hence of our ſouls immateriality, will be not a whit leſs, than either of the two former: for let us caſt our looks over all that committeth into our ſenſes, and ſee if from one end to another, we can meet with ſuch a thing as we call a *reſpect*: it hath neither figure, nor colour, nor ſmell, nor motion, nor taſte, nor touch; it hath no ſimilitude to be drawn out of by means of our ſenſes: to be *like*, to be *half*, to be *cauſe*, or *effect*, what is it? The things (indeed) that are ſo, have their reſemblances and pictures; but which way ſhould a Painter go about to draw

draw a *likeneſs*? Or to paint a *half*, or a *cauſe*, or an *effect*? if we have any underſtanding, we cannot chooſe but underſtand, that theſe notions are extremely different from whatſoever cometh in unto us by the mediation of our ſenſes: and then if we reflect, how the whole negotiation of our underſtanding is *in*, and by *reſpects*; muſt it not follow neceſſarily, that our ſoul is of an extreme different nature from our ſenſes, and from our imagination? Nay, if we look well into this Argument, we ſhall ſee, that whereas *Ariſtotle* pretendeth, that *Nihil eſt in intellectu quod non prius fuit in ſenſu*; this Maxim is ſo far from being true, (in rigour of the words) that the quite contrary followeth undeniably out of it; to wit, that *Nihil eſt in intellectu quod fuit prius in ſenſu*. Which I do not ſay to contradict *Ariſtotle* (for his words are true in the meaning he ſpoke them;) but to ſhew, how things are ſo much changed by coming into the underſtanding and into the ſoul, that although on the one ſide, they be the very ſame things, yet on the other ſide, there remaineth no likeneſs at all between them in themſelves, as they are in the underſtanding; which is a moſt evident proof, (when the weight of it is duly conſidered) that the nature of our ſoul, is mainly different from the nature of corporeal things, that come into our ſenſe.

5. That corporeal things are ſpiritualized in the underſtanding by means of the ſouls working in and by reſpects.

By this which we now come from declaring, the admiration, how corporeal things can be in the ſoul, and how they are ſpiritualized by their own being ſo, will in part be taken away: for reflecting that all the notions of the ſoul, are nothing but the general notion of a *ſubſtance*, or of a *thing* jovned with ſome particular *reſpect*; if we conſider, that the reſpects may be ſo ordered, that one reſpect may be included in another, we ſhall ſee, that there may be ſome one reſpect, which may include all thoſe reſpects that explicate the nature of ſome one thing: and in this caſe, the general notion of a thing *coupled* with this reſpect, will contain all whatſoever is in the thing: as for example, the notion of a knife, *that it is a thing to cut withall*, includeth (as we have formerly declared) all that belongeth unto a knife: And thus you ſee, how that myſtical phraſe, of corporeal things being ſpiritualized in the ſoul, ſignifieth no more, but that the ſimilitudes which are of them in the ſoul, are *reſpects*.

6. That the abſtracting of notions from all particular and individual accidents, doth prove the immateriality of the ſoul.

Thus having collected out of the nature of *apprehenſions* in common, as much as we conceive needfull in this place to prove our

our assertion, our next work must be, to try if we can do the like, by reflecting upon particular *apprehensions*. We considered them of two sorts, calling one kinde, *universal* ones; and the other, *collective* ones: in the universal ones, we took notice of two conditions, the *abstraction*, and the *universality* of them: now truly if we had no other evidence, but what will rise from the first of these, that alone would convince and carry the conclusion: for though among corporeal things, the same may be now in one place, now in another, or sometimes have one figure, sometimes another, and still be the same things, as for example wax or water; yet, it is impossible to imagin any bodily thing whatsoever, to be at any time without all kind of figure, or without any place at all, or indifferent to this or to that; and nevertheless, all things whatsoever, when they are universally apprehended by the soul, have this condition in her, by reason of their abstraction there, which in themselves is impossible unto them. When we say, water, fire, gold, silver, bread, &c. do we meah or express any determinate figure? if we do, none but that precise figure, will serve or content us: but it *is* evident, that of a hundred different ones, any and every one doth alike intirely satisfie us: when we call for money, if we reflect upon our fansie, peradventure we shall finde there a purse of crowns: nevertheless, if our messenger brings us a purse of pistols, we shall not except against it, as not being what we intended in our mind, because it is not that which was painted in our fansie: it is therefore evident, that our meaning and our fansie were different; for otherwise, nothing would have satisfied us, but that which was in our fansie. Likewise in the very word (which is the picture of our notion) we see an indifferency; for no dictionary will tell us, that this word *money* doth not signifie as well pistols as crowns: and accordingly we see, that if our meaning had been precisely of crowns, we should have blamed our selves for not having named crowns, and not him that brought us pistols, when we spoke to him by the name of money: and therefore it is most clear, that our understanding or meaning is not fixed or determined to any one particular; but it is equally indifferent to all: and consequensly, that it cannot be like any thing which entreth by the senses; and therefore not corporeal.

7. That the universality of abstracted notions doth prove the same.

The second condition of *universal apprehensions*, is their *universality*, which addeth unto their abstraction, one admirable par-

cularity, and it is, that they abſtract in ſuch ſort, as to expreſs at the ſame time even the very thing they abſtract from. How is it poſſible that the ſame thing can be, and not be in the ſame notion? Yet let a man conſider what he meaneth when he ſaith, *every man hath two eyes*, and he ſhall ſee that he expreſſeth nothing, whereby any one man is diſtinguiſhed from another: and yet the force of this word *every*, doth expreſs that every man is diſtinguiſhed from another; ſo that in truth, he expreſſeth particularity it ſelf in common. Now let our ſmarteſt and ingenuouſeſt adverſary, ſhew or imagine if he can, how this may be done in a picture, or in a ſtatue, or in any reſemblance of a body or bodily thing: but if he cannot, let him acknowledge an eminent and ſingular propriety in the ſoul, that is able to do it.

Let us reflect, that particularity in a body, is a collection of divers qualities & circumſtances; as that it is white, of ſuch a figure, in ſuch a place, in ſuch a time, and an infinitude of ſuch like conditions, conglobated together: then if our ſoul be a body, the expreſſion of the particularity of a body in the ſoul, muſt be a participation in her of ſuch a conglobation, or of ſuch things conglobated. Now let us imagine if we can, how ſuch a participation ſhould be in common, and ſhould abſtract from all colour, all place, and all thoſe things of which the conglobation conſiſteth, and yet we ſee that in the ſoul this is done; and he who ſaith *Every man*, doth not expreſs any colour, place, or time, and nevertheleſs he doth by ſaying ſo expreſs, that in every man there is a conglobation of color, place, & time: for it could not be *Every one*, unleſs there were ſuch conglobations to make *every one, one:* & if any conglobation were expreſſed in this term *Every one*, it would not be *Every one*, but only *one alone*. Now if any coordination of parts can unfold and lay open this riddle, I will renounce all Philoſophy & underſtanding.

3. That collective apprehenſions do prove the ſame.

Collective apprehenſions will afford us no meaner teſtimony than the other two, for the ſpirituality of our ſoul: for although it may ſeem unto us, before we reflect throughly on the matter, that we ſee, or otherwiſe diſcern by our ſenſe, the numbers of things; as that the men in the next room, are there; that the chairs there, are ten; and the like of other things; yet after due conſideration, we ſhall find, that our eye, or ſenſe telleth us but ſingly of each one, that it is *one*; and ſo runneth over every one of them, keeping them ſtill each by themſelves, under their own ſeveral

unities:

unities: but then the underſtanding commeth, and joyneth under one notion, what the ſenſe kept aſunder in ſo many ſeveral ones, as there are *things*. The notion of *three*, or of *ten*, is not in the *things*, but in our minde; for why three rather than five, or ten rather than twelve, if the matter of which we ſpeak were not determined? and ſuch determination of the matter, is an effect of the underſtanding. If I had ſpoken of *things*, as I did of men, or of chairs, there had been more than three or ten: it is then evident, that what determined my ſpeech, made the number be three or ten.

Again, we ſee that the notion of *ten*, is but one notion; for as the name of ten, is but one ſign, ſo it argueth, that there is but one notion, by which it is the ſign of ten things. Beſides, we ſee that Arithmeticians do finde out the proprieties and particular nature of any determinate number: & therfore we may conclude, that every number hath a definition, and a peculiar nature of its own, as it is a number. If then this definition, or nature, or notion of *ten*, be a corporeal one, it is a corporeal ſimilitude of the object. But is it like to any one of the things, or is it like to all the ten? If to any one, then that one will be ten; if it be like to the whole made of ten, then that whole being but one, ten will be juſt one, and not ten things.

Beſides, to be *ten*, doth expreſly imply to be *not one*: how then can that be a material thing, which by being one repreſenteth many? Seeing that in material things, *one* and *many* are oppoſite, and exclude one another from the ſame ſubject? And yet, this notion could not repreſent many together, but by being one.

Again, if it be a material notion or ſimilitude, it is either in an indiviſible of the brain, or it is in a diviſible part of it: I mean, that the whole eſſence of the notion be in every part never ſo little of the brain, or that one part of the eſſence, be in one part of the brain, and that another part of the eſſence, be in another part of the brain: If you ſay, that the whole eſſence is in every part of the brain, though never ſo little, you make it impoſſible that it ſhould be a body; for you make it the likeneſs of ten determinate bodies, in an indiviſible manner; ſeeing that what by diviſion groweth not leſſe, hath the nature of an indiviſible: but if you ſay, that divers parts of the eſſence, are in divers parts of

of the brain, then you make it impoſſible that the notion of ten, ſhould be indiviſible; ſince it ſelf is compoſed of ſeveral parts.

In a word, ten things cannot be repreſented materially, but by ten other things: and therefore it is moſt evident, that the ſoul which repreſenteth ten by one thing or notion, doth not repreſent the ten materially: and conſequently, that her ſelf is immaterial.

What we have now ſaid, will be confirmed by conſidering the terms, *All* and *whole*: for it is clear, that theſe terms alſo, are of the nature of numbers; but withall, do expreſſe particularly that no part is wanting. If then the notion of *All* or *whole*, be ſaid to be material or quantitative, it muſt be diviſible: but if you divide it, no part remaineth *All* or *whole*: it is not therefore diviſible; and conſequently it is not material. And as this argument is manifeſtly applyable to numbers, ſo if we look into the arguments concerning numbers, you will finde all them likewiſe applyable to theſe terms, *All* and *whole*.

9. The operations of the ſoul drawing alwaies from multitude to unity, do prove the ſame.

Out of what hath been hitherto diſcovered, we may gather this note: That it is the nature of the ſoul, to draw from diviſibility, to indiviſibility; from multitude, to unity; from indeterminateneſs and confuſion, to a clarity and determination: as appeareth evidently in this laſt example of *Collections*; in which, whether we take numbers, or other collective terms, we ſee that throughout their natures do conſiſt in ſuch a perfect indiviſibility, as no part can be ſeparated without deſtroying the eſſence of the notion: nay, things which in themſelves are many and conſiſt in parts, do in the minde get an impartible nature; for *ten*, is no longer *ten*, if it be divided: nor *all*, is *all*, if any thing be taken away. In the ſame manner, though Philoſophy teach us, there be neither points in bigneſs, nor inſtants in motion or time, yet nature maketh us expreſſe all bigneſs by points, and all time by inſtants; the ſoul ever fixing it ſelf upon indiviſibility.

And this is the reaſon, why we attribute the nature of ſubſtance to all our notions: if we ſee a thing white, or black, or do, or ſuffer, or be in a place, or in time; preſently in our apprehenſions we conceive theſe modifications of the thing, like ſubſtances; and accordingly we call them by ſubſtantive names, *Whiteneſs Action*,

Action, Vbication, Duration, &c. Now the reaſon of this is, becauſe a ſubſtance, (that is terminated within it ſelf) is a fit and a ſtady ground for the ſoul to fix it ſelf upon, whereas theſe other Appendixes of ſubſtance, would not afford her eaſie footing to build her ſtructures upon, if ſhe conſidered them as truly they are in themſelves: and therefore in her notion, ſhe giveth them the qualities of ſubſtance: butwithall it happeneth many times, that by her doing thus, if ſhe be not very wary, ſhe is deceived and falleth into groſſe errors.

10. The difference betwixt the notion of a thing in our underſtanding, and the impreſſion that correſpondeth to the ſame thing in our fanſie, doth prove the ſame.

One thing more we muſt remember to take notice of; and it is, that if we will compare the notions in our underſtanding, with the ſigns which beating in our fanſie do beget thoſe notions; we ſhall finde, that theſe are but barely ſigns: and do not in their own nature expreſſe, either the notions they raiſe, or the things they are ſigns of. This is evident in the images of the ſounds we call *words*: for it is clear, they have no likeneſſe either with the things they ſignifie, or with the thoughts they beget in us: and we ſhall finde it no leſs true of other images; for example, in the exteriour impreſſions of ſenſible *qualities*, which ſeem by themſelves to be in the underſtanding; for if we conſider the matter well, we ſhall perceive that we underſtand nothing more by them, than we do by meer words; and that to work, or to diſcourſe out of them, we muſt ſeek into the objects, and their definitions; whereof we learn nothing by thoſe firſt impreſſions: for it ſeemeth, that (for example) hot, or red, or ſweet, to a man that firſt ſeeth, or feeleth, or taſteth them, ſignifieth nothing elſe, but a thing which maketh ſuch an apprehenſion in his ſoul, or ſuch a phantaſm in his interiour ſenſe; and nevertheleſs, as yet the man knoweth not that he hath a ſoul, or and interiour ſenſe; nor doth reflect ſo far as to conſider, that this motion paſſeth by his exterior ſenſe; but his apprehenſion is immediately carried to the thing without him; and he imagineth that the impreſſion he feeleth, is in the thing he feeleth; and ſo he that ſhould feel himſelf heated by a burning glaſſe, and were not acquainted with the vertue of ſuch a glaſſe, would think the glaſſe were hot: yet certainly, his firſt apprehenſion is of the motion made in his fanſie, (though he imagineth it elſewhere) which he conceiveth to be the nature of the thing that maketh it. And thus we ſee that the converſion of the ſoul, is immediate to a thing without

without the man: which alſo is the effect of her being fixed to *Exiſtence*; for by reaſon of that, ſhe ſtill apprehendeth every impreſſion as a *thing*.

But now, whether her apprehenſion doth include the very impreſſion, which is in the ſenſe or in the fanſie, ſo that by its own likeneſs it be in the ſoul, or whether the impreſſion in the fanſie maketh a change in the ſoul, which we cannot diſcern in it ſelf, but conceive it to be the impreſſion which is in the fanſie, becauſe that impreſſion is at the firſt continually preſent at the ſaid mutation; is more obſcure and hard to diſcover. But when we reflect, that after ſome time, words do ſucceed in lieu of this impreſſion, and do perform the ſame effect as the original impreſſion, in what language ſoever they be uttered, ſo they be underſtood; we may conclude out of this evident ſign, that the impreſſion is in the underſtanding not in its own likeneſſe, but in another ſhape, which we do not diſcover; and which is excitated, as well by the name, as by the impreſſion, in a man that is uſed to the names.

Again, in a man that learneth things by himſelf, theſe impreſſions ſerve for words, and not for things; for ſuch a man never looketh into his fanſie to diſcourſe upon any thing, but only upon the mutation he conceiveth is made in the extern ſenſe: out of which he gathereth by little and little, the nature of the thing, whoſe notion was made at firſt in him by this impreſſion. Out of which it is manifeſt, that our knowledge is as different a thing, from the Phantaſms which beat at the ſouls door, as the thing ſignified is from the ſound of the word, or as the wine in the cellar is from the buſh: and therefore, it is impoſſible that the ſoul (in which that knowledge reſideth, and which indeed is that knowledge) ſhould be a corporeal or bodily thing: ſince of all bodily things, the motions that are made by the ſenſible qualities, arrive neereſt to a ſpirituall nature.

11. The apprehenſion of negations and privations do prove the ſame.

I remaineth now, that we ſhould argue for the immateriality of the ſoul, out of the extent of our *apprehenſion*: which ſeemeth to be ſo exceſſive, as not to be comprehenſible by the limitations of bodies; and therefore cannot belong unto a body: but becauſe all that needeth to be ſaid in this particular, followeth plainly out of grounds already urged, and that this Point containeth not any notable particularity deſerving mention here; we will not enlarge

large our ſelves any further upon it, but will paſſe on to the next line of operations proper unto our mind.

Only we may not omit taking notice of the expreſſions which our mind maketh of *nothing*, or as Logicians term it, of *Negations* and *Privations*: which do argue an admirable power in the ſoul, and of a quite different ſtrain from all corporeal things; and do evidently convince the immateriality of it: for it cannot be doubted, but that the ſoul knoweth what ſhe meaneth, when ſhe diſcourſeth of *Nothing*. Now if all her knowledge, were nothing elſe but corporeal phantaſms, or pictures made by corporeal things, how ſhould ſhe come to have a notion of *Nothing*? for ſince it is moſt clear, that *ſomething* cannot be like *Nothing*, and that there cannot be a participation of what *is not*; how can we conceive that there ſhould be a ſimilitude made of *Nothing*?

The way therefore that the ſoul taketh in this operation, is, that comparing two things together, and finding that the one of them is not the other; ſhe reflecteth upon her own action, and dividing in it the thing ſaid, from the ſaying, ſhe taketh the thing ſaid for a quality, or property, or predicate (as Logicians call it) of that thing which ſhe denyeth to be the other thing; and then ſhe giveth it a poſitive name, after ſhe hath firſt made a poſitive notion, unto which the name may agree: as for example, when the ſoul conſidereth a man that hath not the power to ſee, as ſoon as ſhe hath to her ſelf pronounced, that he hath not ſuch a power, ſhe taketh the *not power to ſee*, for a quality of that man; and then giveth the name of *blindneſs* to that *not power of ſeeing*; which though of it ſelf it be nothing, yet by being that which ſatisfieth her act, when ſhe ſaith that he hath not the power of ſeeing, it ſeemeth to be ranked among thoſe things, unto which names are due: for it hath a notion; and the having a notion, is the claim, or merit, or dignity, in vertue whereof things are preferred to names.

Now then, let us enquire how the power of rarity and denſity, or the multiplication and order of parts, can be raiſed and refined to the ſtate of being like *nothing*, or of being the ſimilitude of a *negation*; or what operation of rarity or denſity, can forge out this notion of *blindneſſe*, which we have explicated: and when we finde, it is beyond their reach to compaſſe, we muſt acknowledge,

ledge, that the ſoul is another kinde of engine, then all thoſe which are in the ſtorehouſe of bodies.

THE SIXTH CHAPTER.

Containing proofs out of our ſouls operations in knowing or deeming any thing, that ſhe is of a ſpiritual nature.

1. The manner of judging or deeming by apprehending two things to be identified, doth prove the ſoule to be immaterial.

OUr next conſideration ſhall be, to ſee what teſtimony our manner of *Judging*, doth yield us of the nature of the ſoul: concerning which, three things offer themſelves, worthy the reflecting on; which are, our manner of thinking; the oppoſition which frequently occurreth in our thoughts, and the nature of truth and of falſhood. As for the firſt, we may remember how we have ſhewed, that all *judgement* or *deeming* is but an apprehenſion of identification, or ſomething immediately following out of it; and that a ſettled *judgement* or *aſſent of the mind* is as it were a limb, or branch, or graft in our ſoul; ſo that we finde that our perceiving of identification between two things, or our ſeeing that the one is the other, is that by which our ſoul encreaſeth. Now, becauſe when two things are identified, the one reacheth not farther than the other, it is clear that this increaſe of the ſoul is not made by parts, which being added one to another do cauſe it to be greater: and therefore, ſince this latter courſe is the only means of increaſe in bodies and in quantity, it is as clear that the nature of the ſoul, is quite different from the nature of all corporeal or Quantitative things.

Again, it is againſt the nature of identification, to be of parts; and therefore, they who take quantity to be one things, and not many things tyed together, do acknowledge that truly there are no parts in it: and this is ſo rigorouſly true, that although we ſpeak of two things that in reality are identified one with another, yet if our words be ſuch, as imply that our underſtanding conſidereth them as diſtinct parts, and by abſtraction giveth them the nature of parts; then they are no longer identified, but in good Logick, we ought in this caſe to deny the one of the other. As for example: though the hand and the foot be the ſame thing, (as we have declared in our firſt Treatiſe) yet becauſe in the name

hand,

hand, there is a secret exclusion of any thing that is not in the definition of a hand, it followeth that in our speech we must say, that a hand is not a foot. Likewise though it be confessed, that the thing which is *rationality* is also *risibility*; nevertheless, it is a solecism in Logick, to say that *rationality* is *risibility*, because it is the nature of these abstracted names, to confine their significations to one definition; and the definitions of these two termes are divers. Out of this consideration it followeth clearly, that seeing the nature of parts, is contrary to the nature of identity; and that the soul in her judgements worketh altogether by identity, it is impossible that her operations should consist of parts, or in any sort resemble any proceeding of Quantitative things.

2. The same is proved by the manner of adprehending opposition in a negative judgment.

The like will be convinced out of the opposition we finde in our thoughts. In it we may consider two things: first the generation of it: next, the incompossibility of opposites in the soul. To begin with the first: we see that in our speaking, opposition is produced by the addition of this word *Not*: as when we say, *not a man*, *not a penny*, *not a word*: and therefore it followeth, that in our soul there is a notion of it, correspondent to the word that expresseth it. Now, seeing that a notion is a thing, and that it is the likeness of its object, or rather the same with the object: let us cast about, how we should of parts and of quantity, make a *nothing*, or an identification to *not*: and when we finde, that it is ridiculous and absurd to go about it, let us conclude, that the manner of working, which our soul useth, is far different from that which is used in bodies, and among material things.

And if you object, that not only a body, but even any other substance whatsoever (suppose it as spiritual as you will) cannot be either like, or identified to *nothing*; and therefore this argument will as well prove that the soul is not a thing or substance, as that it is not a body: we answer, that it is evident out of what we have already said, that the understanding is not the objects it understandeth, by way of similitude, but by a higher means; which we have shewed to be by way of *Respects*. Now then, the respect which the thing hath to another thing, by not having such a respect unto it, as a third thing formerly considered hath thereunto, may be expressed in way of *Respects*, though it cannot in way of similitude: and so our understanding is able to expresse, what

what neither our fanſie, nor any corporeal thing can arrive to the expreſſion of: as when firſt we finde, that one man hath a reſpect to the wall, which we call the power of ſeeing it, if afterwards we finde that another man hath a reſpect unto the wall of impotence, that he cannot ſee it, this ſecond reſpect the underſtanding hath a power to expreſſe as well as the firſt: as we have touched above.

3. That things in themſelves oppoſite to one another having no oppoſition in the ſoul, doth prove the ſame.

As for the oppoſition that occurreth in our thoughts, we may conſider it of two kindes: the one is of the things or objects that come into our thoughts or into our ſoul and this is not properly an oppoſition in the ſoul; for although the things be oppoſite by their own nature in themſelves, yet they do not exerciſe their oppoſition in the ſoul: nay, though the oppoſition be even in the ſoul it ſelf, if the ſoul with this oppoſition, be conſidered as an object, it maketh no oppoſition in the ſoul; for ſo you may conſider your ſoul learned and unlearned, ignorant & knowing, good and bad, and the like: all which are oppoſitions in a ſoul ſuppoſed to be ſo qualified, but are no oppoſitions in a ſoul that conſidereth them: no more than fire and water, heavy things and light, white and black, being and not being, an affirmative propoſition and its negative, and the like: all which are in themſelves ſo contrary and oppoſite to one another, that they cannot conſiſt together in one ſubject; they have an incompoſſibility among themſelves, whereſoever the one of them is, by its very entrance it driveth out its oppoſite: and yet in the ſoul they agree together without reluctance: ſhe knoweth and conſidereth and weigheth both ſides of the ſcale at the ſame time, and ballanceth them evenly one againſt another: for unleſſe both the oppoſites were in the ſame inſtant in the ſame comparing power, that power could not by one act whoſe beginning implyeth its ending, judge the difference and oppoſition of them: as when we ſay *black is contrary to white*, or *darkneſſe is the want of light*, we pronounce one common *not being* of both extremes.

We may then boldly conclude, that ſince no body, what ſoever can entertain at the ſame time, and in the ſame place, theſe quarrelling Antagoniſts, but that by their conflict, they preſently deſtroy one another, and peradventure the body too, into which they preſſe for entrance, and the entire poſſeſſion of which each of them ſtriveth for; (thoſe of them I mean, that are proportioned

tioned to the reception of bodies) and that the ſoul imbibeth them together without any difficulty or contraſt, and preſerveth them alwaies friends even in the face of one another, and lodgeth them together in the ſame bed; and that (in a word) theſe oppoſite things do enjoy an admirable and unknown manner of *Being* in the ſoul, and which hath no parallel nor argument in bodily things: we may (I ſay) boldly conclude, that the ſoul it ſelf, in which all theſe are, is of a nature, and hath a manner of *Being* altogether unlike the nature of bodies, and their manner of *Being*.

4. That the firſt truths are identified to the ſoul.

Out of this agreeing of all objects in the ſoul, and their having no oppoſition there, even whiles ſhe knoweth the oppoſition that is between them in themſelves, there followeth another conſideration, of no leſſe importance: which is, that the amplitude of our ſoul in reſpect of knowledge, is abſolutely infinite; that is to ſay, ſhe is capable of knowing at the ſame time objects without end or meaſure. For the explicating whereof, we are to conſider, that the latter concluſions, which the ſoul gaineth knowledge of, do hang to the former by identification, or by the ſouls ſeeing that two notions are identified, becauſe they are identified to a third, as is before expreſſed; and the firſt principles which ſeem to be immediately joyned unto the ſoul, have the identity of their terms plain and evident, even in the very terms themſelves. Nay, if we inſiſt further, we ſhall finde that the firſt truths muſt have an identification to the very ſoul it ſelf; for it being evident that truth or falſhood is not in the ſoul, but ſo far forth as ſhe doth apply her ſelf to the external object, or to the exiſtence of things in themſelves; and that we finde that the ſouls knowing with evidence that any thing *is* or *hath being*, implyeth her knowing that her ſelf *is*; (for ſhe cannot know that a thing ſeemeth ſo to her, or maketh ſuch an impreſſion in her, without knowing that her ſelf *is*; though peradventure ſhe may not know what her ſelf is, but taketh her ſelf to be no other thing than the body of the man in which ſhe is) it is evident that the firſt truths which enter into the ſoul, to wit, that this or that ſeemeth ſo or ſo unto her, (and theſe truthes no ſceptick ever doubted of) are identified with the ſoul it ſelf; ſeeing that an

object seeming to be such or such, is nothing else, but the soul is so qualified.

And in this we finde, that the certainty of the first *Principles*, as for example of this Proposition, *That the whole is bigger than the Part*, will depend in a particular soul of her certainty of her own *Being*: for although this Proposition would have a necessity in the very connexion of the terms, notwithstanding there were not in nature any *whole* or *Part*; yet this necessity would not be a necessity of *Existence* or of *Being* in the object, but a necessity of connexion, as it were of two parts of the soul: and so, if verity and falsity be not perfectly in the soul, but in the comparison to actual existence, the soul would not be perfectly true, or (to say more properly) would not have the perfection of truth in her, by having or knowing this Proposition, unless withall she were certain, that there were existent, an object of this Proposition: of which (as we have said) she cannot be certain, without being certain of her own *Being*; so that in effect, the identification of other things among themselves, by which such things are known, doth come at the last to be retrived in the existence of the soul it self, and to be in the soul, by the identification of those other things unto her self.

5. That the soul hath an infinite capacity, and consequently is immaterial.

Now then to proceed to the proof of our proposed conclusion, it is clear, that the adding of one thing to another, doth out of the force of this addition, perfect the thing unto which the addition is made, if the advenient thing be added in such way, as the former is apt to receive it: but it is evident, that the soul is made fit by former Propositions, to be identified to latter ones; for we see that the former ones draw on, and inferre the latter ones: and therefore it followeth, that the more is added to the soul, the greater is her aptitude to have more, or to be more encreased: and consequently, that the more is added unto her, the more may still be added; and the more capable and more earnest she is, to have more. Wherefore it cannot be denyed, but that since in the nature of the objects there is no impediment to hinder their being together in the soul, (as we have proved a little above) and that in her by receiving new objects into her, there is a continual encrease of capacity to receive more; she hath an amplitude to knowledge absolutely

absolutely infinite, in such a manner as we have above expressed.

Now to apply to our purpose what we have gathered by this discourse, it is clear, that these two conditions of *one thing not driving out another*, and of *infinity of accessions*, do openly disclaim from quantity, and from matter; for we see that what hath Quantity, or is a body, cannot admit a new thing into it, unless some other thing do first go out of it, to make room for the advenient one: and as for infinitude, it breedeth a sea of contradictions, if it be but thought of in Quantity: and therefore we may conclude, that the soul, unto whom these two conditions do belong, is not quantitative or corporeal, but immaterial, and of a spiritual nature.

6. That the opposition of contradictory Propositions in the Soul doth prove her immateriality.

The second kinde of opposition, that occureth in our thoughts, or in our soul, is of *Contradictory Propositions*: it hath its origine in the opposition of *Being* to not *Being*: and is when a thing is identified unto the soul, in such sort as we have said, that a *Judgment* or *Deeming* maketh the object become as it were a limb, or part of the soul: and because the conflict of two such Propositions, if they were together in the soul, would make her be something contrary to the nature of *Being* (if any thing can *be* contrary to *Being*) which in the schools they call *ens & non ens*; the impossibility of her admitting into her self two such Propositions together, doth testifie her firm cleaving and her fixednesse to *Being*: and so doth confirm and bring new evidence to that argument for the souls spirituality, which in the first Chapter of this part, we drew from the nature of *Being*.

As for truth and falshood, they spring from the same root as the last; as being qualities consequent to the opposition of affirmative and negative Propositions; whereof if the one be true, the other must necessarily be false: and therefore, we need not spend time in setting down any particular considerations of these; since what we have said of the other, is applyable unto them: but it is sufficient, that we thus note them, to give the Reader occasion to reflect upon them.

7. How Propositions of *eternal truth*, do prove the immateriality of the soul.

Among Propositions, there are some which Logicians do term *of eternal Truth*: and out of these, there are ingenious men, who imagine that the immortality of the soul may be immediately deduced. Herein they rove not quite from the mark; though withall

withall I muſt needs ſay, they do not directly hit it. To underſtand the utmoſt that may be inferred out of ſuch Propoſitions, we may note two conditions in them: the firſt is, that generally theſe Popoſitions are univerſal ones; and thereby have that force to convince the ſpirituality of the ſoul, which we have explicated and ſhewed to belong unto univerſal terms: the ſecond is, that in theſe Propoſitions, there is a neceſſity of connexion between their terms; ſuch an one, or at the leaſt very like there. unto, as we explicated in thoſe Propoſitions, which bear their evidence plain in their very termes. And out of this we may draw another argument for the ſpirituality of the ſoul: for we ſee that all corporeal agents and patients, are defectible and contingent; that is to ſay, ſometimes, or if (if you will) moſt times, they attain their effect; but withall, ſometimes (be it never ſo ſeldom) they miſſe of it: and accordingly, it happeneth ſometimes that our eyes, our ears, our touch, and the reſt of our ſenſes are deceived; though for the moſt part, they give us true informations of what they converſe with: but theſe Propoſitions of eternal verity do never fail: they have in themſelves an indefectibility inſuperable; and conſequently, they give evidence that the ſouls nature is of a higher degree of conſtancy and certainty, than what falleth within the compaſſ of bodies: and is of a nobler and different ſtrain, from all corporeal things: for this certainty is entailed upon ſuch Propoſitions by the force of *Being*; which is the proper object of the ſoul: and they have their *Being*, as limbs and parts of the ſoul.

As for the term of *Eternal verity*, it is not to be taken poſitively, as if theſe Propoſitions, or their objects, had any true eternity or perſeverance, without beginning or ending: but only negatively; that is, that there can be no time, in which they are falſe: and therefore, we cannot out of their having ſuch a kinde of Eternity belonging to them, argue a capacity of infinite time or duration in our ſoul that comprehendeth them.

THE

THE SEVENTH CHAPTER.

That our discoursing doth prove our soul to be incorporeal.

HAving thus run over those proofs for the Immateriality of our soul, which arise out of her manner of working when she judgeth; in the next place, we are to enquire what others, her manner of discoursing will afford us. We are sure, that since our discourse is composed of judgements, and of single apprehensions, it cannot choose but furnish us with all those pregnant arguments, that we drew from them. But that will not serve our turn: we look after new evidence: and we shall see it will give it us with full hands. It consisteth in this: that when we discourse, we may easily perceive there is more at one time in our minde, than we can discover to be in our fantasie; for we finde, that in our fantasie, as one Proposition cometh, another is gone: and although they that are gone, seem to be ready at a call, yet they are not in presence; as being things which consist in motion, and that require place; and therefore the one justleth the other out of the place it possessed. But if it fared in like manner in our inward soul, we could never attain unto knowledge: for it is manifest, that our soul is not assured of a conclusion, but by her seeing the premisses: if then the premisses be taken away, the conclusion that resteth upon them, falleth to the ground: but they are taken away, if they be out of our mind: therefore, when our understanding yeeldeth its assent to a conclusion, it must of necessity have the premisses still in it.

1. That in discoursing the soul containeth more in it at the same time, than is in the fantasie, which proveth her to be immaterial.

But we must not rest here; this consideration will carry us on a wondrous deal farther: we know, that whoso goeth to frame a new demonstration in any subject, must be certain he taketh nothing contrary to what he hath learned in many books: likewise, that who will make a Latine Verse, or readeth a Poem, knoweth there is nothing in all that Poem contrary to his Prosodia: do we not then manifestly perceive a certain remainder of all these in his soul? The like is in all arts: in which he

that goeth about any work according to art, sheweth he hath in his head all the rules of that art, though he do not distinctly remember them, or call them to minde whiles he worketh: for if he have them not, how doth he work by them? Since then it is clear that he thinketh not of them at that time, it is as clear, that more is in the soul at one time, than is in his fantasie, or than can be there by material bodies, (which we have shewed is the way, whereby all things come into the fantasie,) although it be the nimblest and the subtilest Agent of all corporeal things whatsoever.

2. That the nature of discourse doth prove the soul to be ordered to infinite knowledge, and consequently to be immaterial.

Another consideration whereby to evince the immateriality of the soul, concerneth the proceeding of syllogisms by links, fastned one to another; whence we may take notice, that every one of them is a step to another: and consequently, it is manifest, that according to the nature of the soul, they must be altogether in her; since, if any one were absent, all the rest that followed and depended upon that one, would have no grounding, nor fixedness in the soul. Now if to this we adde, that what is to be known, is absolutely and liquidly infinite, there cannot be brought or expected a more pregnant and home witness of our souls spirituality: it following out of these grounds; that the soul by its nature, is not onely capable of, but is expressly ordered to an infinite knowledge of infinite objects altogether; for these two, *finite* and *infinite* science, are so vastly different from one another, that if the same subject be capable of both, it must of necessity be ordered to infinite, as to its chiefest act and end: and thus out of *capacity* in this subject, *its being ordered* is well inferred; though in other matters peradventure the consequence may not be good. And accordingly who looketh into *Geometry*, *Arithmetick*, *Logick*, or even *nature* it self, will evidently see that the objects of knowledge, are every way, and in every science, multipliable without end.

3. That the most natural objects of the soul are immaterial, and consequently the soul her self is such.

Neither ought this to be neglected, that a great part of the souls objects, and indeed of those that are most natural to her, is above the capacity, and out of the reach of material things. All Metaphysicks abstract from quantity: the investigation of God, or Angels, of the soul, or its self, either concludeth immateriality, or at the least worketh about it.

What

What ſhall I ſay of Logical notions, of thoſe which are called the *ſecond intentions*; about which there is ſo much buſineſs both in the ſchools and in the world? It is ſufficient that we have already expreſſed, how all our notions are *reſpective*. But in particular the motives of humane actions are very abſtracted conſiderations: as for example, hope of things to come, memory of things paſſed, vertue, vice, honour, ſhame, and the like. To theſe let us add, that when we teach or explicate any thing to ignorant perſons, we muſt frame our own apprehenſions to their capacity, and we muſt ſpeak ſuch things as they may comprehend: which capacity or extent of comprehenſion we cannot ſee nor perceive by any ſenſe, but we judge it meerly by our Reaſon, and by our Underſtanding. Wherefore, ſeeing that our operation is mainly and chiefly on and by ſuch motives, as are not liable to material principles and compoſitions, it is evident, that the ſpring-head from whence ſuch an operation floweth, muſt alſo be immaterial and incorporeal.

I am not ignorant, that this argument uſeth to be anſwered by urging, that the ſoul likewiſe knoweth *Deafneſs*, *Dumbneſs*, *Blindneſs*, and ſuch other notions of *Nothings*; and yet is not from thence inferred to be *nothing*; it conceiveth God and Eternity; and yet it is neither from it ſelf, as God is, nor eternal. In like manner (ſay they) it may know incorporeal things, and yet not be therefore it ſelf incorporeal. To this I reply, firſt wiſhing them not to miſtake me, but to give my argument its full force and weight: for there is a very great difference between the knowing of a thing, in a ſtrained, toilſom, and confuſed manner, and the having a thing for its ordinary matter and ſubject of negotiation: this argueth connaturality between the ſoul, and what it is in ſuch ſort converſant about; but that doth not. Now what is inferred out of whole ſciences and arts, concerneth a main ſtock of the ſouls buſineſs, and not ſome extraordinary vertue or powers ſhe hath.

But to come up to cloſe to the anſwer: I ſay, that if we being throughly acquainted with material things, can finde that it is not in the poſſibility of any ſuch to be the likeneſs of an immaterial thing; and from thence do infer that our ſoul, for being

fraught with immaterial notions, is not material; our concluſion is well collected, and a very good one; for the premiſes out of which we do gather it, are within our kenning; and therefore if there were any defect in the conſequence, we ſhould eaſily perceive it. Whence it appeareth clearly, that there is no parity between the deduction of our concluſion, and that other which the objection urgeth, that our ſoul, becauſe it can know eternal things, is alſo eternal; for eternity is a thing beyond our comprehenſion: and therefore it ought not to be expected at our hands, that we ſhould be able to give an account where the brack is. And to ſay the truth, if *knowledge* be taken properly, we do not know eternity; however by ſupernatural helps we may come to know it; but in that caſe, the helps are likely to be proportionable to the effect. Neither are negations properly known, ſeeing there is nothing to be known of them. And thus we ſee that theſe objections do proceed from the equivocation of the word *knowledge*; ſometimes uſed properly, otherwhiles applied abuſively.

THE EIGHTH CHAPTER.

Containing proofs out of our manner of proceeding to action, that our ſoul is incorporeal.

1. That the ſouls being a power to order things proveth her to be immaterial.

I Doubt not but what we have already ſaid, hath ſufficiently convinced our ſouls being immaterial, unto whomſoever is able to penetrate the force of the arguments we have brought for proof thereof, and will take the pains to conſider them duly: (which muſt be done, by ſerious and continued reflection, and not by curſary reading, or by interrupted attempts) yet ſince we have ſtill a whole field of proofs untouched, and that in ſo important a matter, no evidence can be too clear, nor any pains be accounted loſt, that may redouble the light, although it ſhine already bright enough to diſcern what we ſeek, we will make up the concert of unanimous teſtimonies to this already eſtabliſhed truth, by adding thoſe arguments we ſhall collect out of the manner of our ſouls proceeding to action, unto

unto the others we have drawn from our observations unto her apprehensions, her judgements, and her discourses.

Looking then into this matter: the first consideration we meet withall, is, that our understanding is in her own nature an *orderer*; and that her proper work is to rank and put things in order: for if we reflect upon the works and arts of men, as, a good life, a common wealth, an army, a house, a garden, all artefacts; what are they, but compositions of well-ordered parts? And in every kind, we see that he is the Master, and the Architect, and is accounted the wisest, and to have the best understanding, who can best, or most, or farther than his fellows, set things in order. If then to this we joyn, that Quantity is a thing whose nature consisteth in a capacity of having parts and multitude, and consequently is the subject of ordering and ranking; doth it not evidently follow, that our soul, compared to the whole mass of bodies, and to the very nature of corporeity or quantity, is as a proper agent to its proper matter to work upon? Which if it be, it must necessarily be of a nobler strain, and of a different and higher nature than it; and consequently, cannot be a body, or be composed of Quantity: for had it matter in it self, what it expecteth and requireth from the agent, it would not need the agents help, but of it self it were fit to be an Agent. Wherefore if the nature of corporeity, or of body, in its full latitude, be *to be ordered*, it followeth that the thing whose nature is to be an *orderer*, must as it is such, be not a body, but of a superiour nature, and exceeding a Body: which we express by calling it a *spiritual thing*.

2 That the souls being able to move without being moved, doth prove her to be immaterial.

Well then, if the soul be *an orderer*, two things belong necessarily unto her: The one is, that she have this order within her self; the other is, that she have power to communicate it unto such things, as are to be ordered. The first she hath by science, of which enough already hath been said towards proving our intent. Next, that her nature is communicative of this order, is evident out of her action and manner of working. But whether of her self she be thus communicative, or be so by her conjunction to the body she informeth, appeareth not from thence. But where Experience falleth short, Reason supplieth, and sheweth us that of her own nature she is communicative of order; for

for seeing that her action is an *ordering*, and that in this line there are but two sorts of things in the world, namely, such as do order and such as are to be ordered; it is manifest, that the action must by nature and in the universal consideration of it, begin from the *orderer* (in whom order hath its life and subsistence) and not from that which is to receive it: then, sithence *ordering* is motion, it followeth evidently, that the soul is a mover and a beginner of motion.

But since we may conceive two sorts of movers; the one, when the agent is moved to move; the other, when of it self it beginneth the motion without being moved; we are to enquire, unto which of these two the soul belongeth. But to apprehend the question rightly, we will illustrate it by an example: let us suppose that some action is fit to begin at ten of the clock: now we may imagine an agent to begin this action in two different manners; the one, That the clock striking ten, breedeth or stirreth somewhat in him, from whence this action followeth; The other manner is, that the agent may of his own nature, have such an actual comprehension or decurrence of time within himself, as that without receiving any warning from abroad, but as though he moved and ordered the clock as well as his own instruments, he may of himself be fit and ready, just at that hour to begin that action; not as if the clock told him what hour it is, but as if he by governing the clock, made that hour to be, as well as he causeth the action to begin at that hour. In the first of these manners, the agent is moved to move; but in the second, he moveth of himself, without being moved by any thing else. And in this second way, our soul of her own nature communicateth her self to quantitative things, and giveth them motion: which followeth out of what we have already proved, that a soul, in her own nature, is the subject of an infinite knowledge, and therefore is capable of having such a general comprehension, as well of time, and of the course of all other things, as of the particular action she is to do; and consequently, standeth not in need of a Monitor without her, to direct her when to begin.

If then it be an imprevaricable law with all bodies, that none whatsoever can move, unless it be moved by another;

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it followeth, that the ſoul which moveth, without being ſtirred or excitated by any thing elſe, is of a higher race than they; and conſequently is immaterial and void of quantity. But let me not be miſtaken in what I come from ſaying; as though my meaning were, that the ſoul exerciſeth this way of moving her ſelf, and of ordering her actions, whiles ſhe is in the body: for how can ſhe, ſeeing ſhe is never endued with compleat knowledge requiſite for any action; never fully comprehending all the circumſtances of it? But what I intend, is that the nature of the ſoul, conſidered in it ſelf, is ſuch, as hath a capacity, and may reach to this manner of working, (whence I infer, that ſhe is not a body but a ſpirit) without determining, whether ſhe work thus in the body, or out of it: that enquiry belongeth not to this place; it will follow by and by.

5. That the ſouls proceeding to action with an univerſality, & indifferency, doth prove the ſame.

But for the preſent, having conſidered unto what kind of working, the nature of the ſoul in abſtract, is capable of attaining; we will conclude this Chapter with reflecting upon thoſe actions of hers, which fall daily under our remark, as being exerciſed in the body. In all of them we may obſerve, that ſhe proceedeth with a certain univerſality and indifferency, beyond the practice of all other creatures whatſoever. For example, if a man be ſpoken to, or asked of a hundred ſeveral things that he never thought of before in all his life, he will immediately ſhape pertinent replies, to all that is ſaid, and return fitting anſwers to every queſtion: As, *Whither ſuch a man goeth? How long this ſtaff is? What colour that mans clothes are of? &c.* To all which, and to as many things more as you will (ſo they be within the compaſs of his knowledge) he ſtraight anſwereth differently, and to the purpoſe. Whence it is manifeſt, that his anſwers do not proceed upon ſet gimals or ſtrings, whereof one being ſtruck, it moveth the reſt in a ſet order, (which we have ſhewed, is the courſe in all actions done by beaſts) but out of a principle within him, which of it ſelf is indifferent to all things; and therefore can readily apply it ſelf to the anſwer, according as by the queſtion it is moved: and the like may be obſerved in his actions; which he varieth according to the occaſion preſented.

I remember how Sir *Philip Sidney* (the Phœnix of the age he lived in, and the glory of our Nation, and the pattern to posterity of a compleat, a gallant, and a perfect Gentleman) aptly calleth our hands, the instruments of instruments; from *Aristotle*, who termeth them *Organa organorum*, or universal instruments, fitly moulded to be employed in any service; whereas nature hath to all other creatures appropriated their instruments to determinate actions, but to man, she hath (in these) given such, as might be applied to any kinde of work whatsoever: and accordingly we see, that the same kind of bird, still buildeth her nest, and breedeth her young ones, in the same way, without any the least variance at all: but men do build their houses as they please, sometimes upon hills, sometimes in vales, sometimes under the earth, and sometimes upon the tops of trees: and the manners of breeding or instructing their children, are as divers, as the customs of Nations and Towns: and in all other actions, our Masters note it for a property peculiar to man, that he useth to arrive unto the same end by divers means, as to transport our selves unto some place wee would go unto, either by water, or by horse, or by coach, or by litter, as we please: whereas we see no such variety in like actions of other living creatures.

All which being so, we may conclude, that the souls proceeding either to answers, or to action, argueth clearly that she hath within her self such an indifferency, as is joyned with a means to determine this indifferency: the contrary whereof we see in all corporeal engines; for they have every step in the whole course of their ways, chalked out unto them, by their very framing (as hath been amply declared in the first Treatise) and have the determination of their work, from end to end set down, and given them by their artificer and maker: and therefore it is most evident, that the soul cannot be a thing composed or framed of material and quantitative parts, seeing she hath not her ways set down unto her, but frameth them of her self, according to the accidents that occur.

4 That the quiet proceeding of reason doth prove the same

The same nature of the soul, discovereth it self in the quiet proceeding of *Reason*, when it worketh with greatest strength and vigour; as well knowing, that its efficaciousness consisteth

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not in the multitude of parts, which *Passion* breedeth, but in the well ordering of those it already hath under its command. Whereas the strength of Quantity, and the encrease of its strength, consisteth in the multitude of its parts; as will evidently appear to whom shall consider this point deeply.

Thus we have in a summary manner gone through all the operations of the soul, which in the beginning of this latter Treatise, we heaped together as material, wherewith to raise an immaterial and spiritual building. Neither, I hope, will our Reader be offended with us, for being more succinct and concise in all our discourse concerning our soul, than where we delivered the doctrine of Bodies: for the difficultnesse of this subject, and the nicety required to the expressing our conceptions concerning it, wherein (as the proverb is) a hair is to be cloven, would not allow us that liberty of ranging about, as when we treated of Bodies. What occurreth among them, may be illustrated by examples within their own orb, and of their own pitch; but to display the operations of a soul, we can finde no instances that are able to reach them; they would rather embroil and darken them: for the exact propriety of words, must be strictly and rigorously observed in them: and the Reader shall penetrate more into the nature and depth of them, by serious meditation and reflection upon the hints we have here given, (efficacious enough, I hope, to excite those thoughts he should have for this purpose, and to steer them the right way) than by much and voluminous reading, or by hearing long and polished discourses of this subject. 5. A conclusion of what hath been said hitherto in this second treatise.

For my part, if what I have here said, should to any man appear not sufficient to convince that our soul is of a spiritual and far different nature, from all such things as in our first Treatise we have discoursed upon, and taken for the heads and most general kindes of Bodies, (unto which all other particular ones, and their motions may be reduced) I shall become a suter to him, in entreating him to take this subject into his handling, where it beginneth to be unwieldy for mine, and to declare unto us, upon the principles we have setled in the first Treatise, and upon considering the nature of a body, (which is the first of all our notions) how these particulars we have reflected upon in

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mans actions, can be drawn out of them; for I can finde no poſſible means to linke them together: a vaſt and impenetrable Ocean lyeth between the diſcoveries we have made on each ſide of its ſhores, which forbiddeth all commerce between them; at the leaſt, on the dark bodies ſide, which hath not wings to ſoar into the region of *Intellectual* light. By thoſe principles, we have traced out the courſe and progreſſe of all operations belonging to ſenſe; and how beaſts do or may perform all their actions, even to their moſt refined and ſubtileſt operations: but beyond them, we have not been able to carry theſe grounds, nor they us. Let him then take the pains to ſhew us, by what figures, by what firſt qualities, by what mixtion of rare and denſe parts, an univerſal apprehenſion, an evident judgement, a legitimate conſequence is made: and ſo of the like; as, of a mans determination of himſelf to anſwer pertinently any queſtion; of his chooſing this way before that, &c. Which if he can do (as I am ſure he cannot) I ſhall allow it to be reaſon, and not obſtinacy, that worketh in his minde, and carryeth him againſt our doctrine: but if he cannot, and that there is no apparence nor poſſibility (as indeed there is not) that theſe actions can be effected by the ordering of material parts, and yet he will be ſtill unſatisfied, without being able to tell why, (for he will be unwilling to acknowledge, that theſe abſtracted ſpeculations, do not ſink in to him, and that nothing can convince him, but what his ſenſes may be judges of, and that he may handle, and turn on every ſide like a brick or a tile) and will be ſtill importune with cavillous ſcruples, and wild doubts, that in truth, and at the bottom do ſignifie nothing, we will leave him to meditate at his leiſure upon what we have ſaid; whiles we proceed on to what followeth out of this great principle, *That our ſoul is incorporeal and ſpiritual.*

THE

THE NINTH CHAPTER.

That our Soul is a Subſtance, *and* Immortal.

HAving concluded that our Soul is immaterial and indiviſible; to proceed one ſtep farther, it cannot be denyed, but that it is either a ſubſtance or an accident; if the latter, it muſt be of the nature of the ſubſtance whoſe accident it is; for ſo we ſee all accidents are: but in man when his ſoul is excluded, there is no ſpiritual ſubſtance at all, whereof we have any notice: and therefore if it be an accident, it muſt be a corporeal accident, or ſome accident of a body; as ſome figure, temperature, harmony, or the like: and conſequently, it muſt be diviſible: but this is contrary to what is proved in the former Chapters: and therefore it cannot be a corporeal accident. Neither can it be a ſpirituall accident; for unto what ſpirituall ſubſtance ſhould it belong, when as nothing in man can be ſuſpected to be ſpiritaul, but it ſelf? Seeing then that it can be no accident, a ſubſtance it muſt be, and muſt have its *Exiſtence* or *Being* in it ſelf. 1. That Mans Soul is a ſubſtance.

Here we have paſſed the Rubicon of experimental knowledge: we are now out of the bounds that experience hath any juriſdiction over: and from henceforth, we muſt in all our ſearches and concluſions relie onely upon the ſingle evidence of Reaſon. And even this laſt concluſion we have been fain to deduce out of the force of abſtracted reaſoning upon what we had gathered before; not by immediate reflection upon ſome action we obſerve proceeding from a man: yet withall, nature flaſheth out by a direct beam, ſome little glimmering of the verity of it, to the ey of Reaſon that is within us: for as when we ſee a clock move, or ſomething any thing that goeth by many wheels, if we mark that there are two contrary motions, in two divers parts of it, we cannot think that thoſe contrary motions, do belong to one and the ſame continued body, but ſhall preſently conclude, that there muſt be in that engine two ſeveral bodies compacted together; ſo in man, though his body be the firſt mover that appeareth untous, yet ſeeing that in his actions, ſome effects do ſhew themſelves, which 2. That Man is compounded of ſome other ſubſtance beſides his body.

which it is impoſſible ſhould proceed from a body, it is evident, that in him there is ſome other thing beſide: that one which we ſee: and conſequently we may conclude, that he is compoſed of a body and of ſomewhat elſe that is not a body: which *ſomewhat elſe*, being the ſpring from whence thoſe actions flow, that are of a different ſtrain from them that are derived from the body, muſt neceſſarily be a ſpiritual ſubſtance.

3. That the ſoul doth ſubſiſt of it ſelf independently of the body.

But whiles we are examining, how far our preſent conſiderations, and ſhort diſcourſes may carry us, as it were experimentally to confirme this truth, we muſt not omit what *Avicenna* in his book *De Anima & Almabad*, and *Monſieur des Cartes* in his Method, do preſſe upon the ſame occaſion. Thus they ſay, or to like purpoſe: If I caſt with my ſelf, who I am that walk, or ſpeak, or think, or order any thing; my reaſon will anſwer me, that although my legs or tongue were gone, and that I could no longer walk or ſpeak, yet were not I gone, and I ſhould know and ſee with my underſtanding, that I were ſtill the very ſame thing, the ſame *Ego* as before. The ſame as of my tongue or legs, would reaſon tell me of my eyes, my ears, my ſmelling, taſting, and feeling, either all of them together, or every one of them ſingle, that were they all gone, ſtill ſhould I remain: As when in a dream, (where I uſe none of all theſe) I both am, and know my ſelf to be. Reaſon will tell me alſo, that although I were not nouriſhed, ſo I were not waſted, (which for the driſt of the argument may be ſuppoſed) yet ſtill I ſhould continue in *being*. Whence it would appear, that my heart, liver, lungs, kidneies, ſtomach, mouth, and what other parts of me ſoever, that ſerve for the nouriſhment of my body, might be ſevered from me, and yet I remain what I am. Nay, if all the beautiful and airy fantaſms, which fly about ſo nimbly in our brain, be nothing elſe but ſigns unto in our ſoul, of what it is without us; it is evident, that though peradventure ſhe would not without their ſervice, exerciſe that which by error we miſ-name *Thinking*; yet the very ſame ſoul and thinker might be without them all: and conſequently, without brain alſo; ſeeing that our brain is but the play-houſe and ſcene, where all theſe faery masks are acted: ſo that in concluſion Reaſon aſſureth us, that when all body is abſtracted in us, there ſtill remaineth a ſubſtance, a thinker, an *Ego*, or *I*, that in it ſelf is no whit diminiſhed, by being (as I may ſay) ſtripped out of the caſe it was incloſed in.

And

And now I hope the intelligent Reader will conceive I have perfor ned my promi:, and have ſhewed the Soul of man to be an *Immortal ſubſtance* : for ſince it is a *ſubſtance*, it hath a *Being*; and ſince it is immaterial ſubſtance, it hath a *Being* of its own force; without needing a conſort body, to help it to ſuſtain its *Exiſtence* : for to be a ſubſtance, is to be the ſubject of *Exiſtence*; and conſequently, to be an immaterial ſubſtance, is to be a ſubject capable of *Exiſtence*, without the help of matter or of Quantity. It cannot therefore be required of me, to uſe any further induſtry, to prove ſuch a ſoul to be immortal : but who will contradict her being ſo, is obliged to ſhew that ſhe is mortal : for it followeth in reaſon, that ſhe will keep her *being*, unleſs by ſome force ſhe be bereaved of it; it being a rule, that whoſoever putteth a thing to be, is not bound, for the continuation of that things being, to prove that it is not changed : but on the other ſide, he that avereth it is changed, is bound to bring in his evidence of a ſufficient cauſe to change it : for to have a thing remain, is Natures own dictamen, and followeth out of the cauſes which gave it *Being*: but to make an alteration, ſuppoſeth a change in the cauſes, and therefores the obligation of proof lyeth on that ſide. 4. Two other arguments to prove the ſame: one poſitive, the other negative.

Nevertheleſs, to give ſatiſaction to thoſe, who are earneſt to ſee every article poſitively proved, we will make that part too our *Province*. Let us then remember, that *Immortality* ſignifieth a negatian, or a not having of *Mortality* : and that a poſitive term, is required to expreſſe a change by; ſince Nature teacheth us, that whatſoever is, will remain with the *Being* it hath, unleſs it be forced out of it : if then we ſhew, that Mans ſoul hath not thoſe grounds in her, which maketh all things we ſee, to be mortal; we muſt be allowed to have acquitted our ſelves of the charge, of proving her *Immortal*. For this end let us look round about us, and inquire of all the things we meet with, by what means they are changed, and come to a period, and are no more. The pure Elements will tell you, that they have their Change, by rarefaction and condenſation, and no otherwiſe : mixed bodies, by alteration of their mixture : ſmall bodies, by the activity of the Elements working upon them; and by the means of rare- 5. The ſame is proved becauſe the ſoul cannot be obnoxious to the cauſe of mortality.

faction and condenſation entering into their very conſtitution, and breeding another temperament, by ſeperation of ſome of their parts, and in their ſtead mingling others. Plants, and Trees and other living Creatures will tell you, that their nouriſhment, being inſinuated through their whole bodies, by ſubtile pores, and blinde paſſages, if they either be ſtoped by any accident, or elſe be filled with bad nouriſhment, the mixture of the whole faileth of it ſelf, and they come to die. Thoſe things which are violently deſtroyed, we ſee are made away, for the moſt part by diviſion; ſo fire by diviſion deſtroyeth all that cometh in its way; ſo living Creatures are deſtroyed, by their parting of their blond from their fleſh, or of one member from another, or by the evaporation or extinction of their natural heat. In fine, we are ſure that all things, which within our knowledge loſe their *Being*, do ſo by reaſon of their Quantity; which by diviſion, or by rarefaction, and compreſſion, gaineth ſome new temperature, that doth not conſiſt with their former temper. After theſe premiſſes, I need ſay no more: the concluſion diſplayeth it ſelf readily and plainly, without any further trouble; for if our labour hath been hitherto, to ſhew that our ſoul is indiviſible, and that her operations are ſuch as admit not quantitative parts in her; it is clear, that ſhe cannot be mortal, by any of thoſe waies whereby we ſee things round about us to periſh.

The like argument we may frame out of local motion; for ſeeing that all the alterative actions we are acquainted withall, be performed by local motion (as is delivered, both in groſſe, and by detail, in our firſt Treatiſe) and that *Ariſtotle*, and all underſtanding Philoſophers do agree, there can be no local motion in an indiviſible thing (the reaſon whereof is evident, to whomſoever reflecteth upon the nature of *Place*, and of *local motion*) it is manifeſt, that there can be no motion to hurt the ſoul, ſince ſhe is concluded to be *indiviſible*.

6 The ſame is proved becauſe the ſoul hath no contrary.

The common argument likewiſe uſed in this matter, amounteth to the ſame effect: to wit, that ſince things are deſtroyed only by their contraries; that thing which hath no contrary, is not ſubject to deſtruction: (which Principle both Reaſon and experience, do every where confirme:) but a humane ſoul is not ſubject to contrariety: and therefore ſuch an one cannot be deſtroyed.

ſtroyed. The truth of the aſſumption, may be known two waies: firſt, becauſe all the contrarieties that are found within our cogniſance, do riſe out of the primary oppoſition of *Rarity*, and *Denſity*; from which the ſoul being abſolutely free, ſhe likewiſe is ſo, from all that groweth out of that root: and ſecondly, we may be ſure, that our ſoul can receive no harm from contrariety; ſince all contraries are ſo far from hurting her, as contrarywiſe, the one helpeth her in the contemplation of the other: and as for contradiction in thoughts, which at different times our ſoul is capable of admitting, experience teacheth us, that ſuch thoughts do change in her, without any prejudice to her ſubſtance, they being accidents, and having their contrariety only betwixt themſelves within her, but no oppoſition at all to her; which only is the contrariety that may have power to harm her: and therefore, whatſoever of ſuch contrary thoughts be in the ſoul, pertaineth no more to her ſubſiſtence, than it doth to the ſubſiſtence of a body, whether it be here or there, on the right hand, or on the left.

7. The ſame is proved from the end for which the ſoul was created.

And thus I conceive my taske is performed; and that I am diſcharged of my undertaking to ſhew the ſouls *Immortality*, which importeth no more, than to ſhew, that the cauſes of other things mortality, do not reach her. Yet being well perſwaded, that my Reader will not be offended with the addition of any new light, in this dark ſubject; I will ſtrive to diſcover (if it be poſſible) ſome poſitive proof, or gueſſe, out of the property and nature of the ſoul it ſelfe, why ſhe muſt remain, and enjoy another life after this. To this end let us caſt our eye back, upon what hath been already ſaid, concerning her nature. We found that *truth* is the natural perfection of Mans ſoul; and that ſhe cannot be aſſured of truth naturally, otherwiſe than by evidence: and therefore it is manifeſt, that evidence of truth, is the full compleat perfection, at which the Soul doth aim. We found alſo, that the ſoul is capable of an abſolute infinity of truth or evidence. To theſe two, we will adde only one thing more, which of it ſelf is paſt queſtion, and therefore needeth no proof; and then we will deduce our concluſion, and this is, that in a man his ſoul is a far nobler, and perfecter part of him, than his body: and therefore, by the rules of Nature and of Wiſdom, his body was made for his ſoul, and not his ſoul finally for his body.

faction and condenſation entering into their very conſtitution, and breeding another temperament, by ſeperation of ſome of their parts, and in their ſtead mingling others. Plants, and Trees and other living Creatures will tell you, that their nouriſhment, being inſinuated through their whole bodies, by ſubtile pores, and blinde paſſages, if they either be ſtoped by any accident, or elſe be filled with bad nouriſhment, the mixture of the whole faileth of it ſelf, and they come to die. Thoſe things which are violently deſtroyed, we ſee are made away, for the moſt part by diviſion; ſo fire by diviſion deſtroyeth all that cometh in its way; ſo living Creatures are deſtroyed, by their parting of their blood from their fleſh, or of one member from another, or by the evaporation or extinction of their natural heat. In fine, we are ſure that all things, which within our knowledge loſe their *Being*, do ſo by reaſon of their Quantity; which by diviſion, or by rarefaction, and compreſſion, gaineth ſome new temperature, that doth not conſiſt with their former temper. After theſe premiſſes, I need ſay no more: the concluſion diſplayeth it ſelf readily and plainly, without any further trouble; for if our labour hath been hitherto, to ſhew that our ſoul is indiviſible, and that her operations are ſuch as admit not quantitative parts in her; it is clear, that ſhe cannot be mortal, by any of thoſe waies whereby we ſee things round about us to periſh.

The like argument we may frame out of local motion; for ſeeing that all the alterative actions we are acquainted withall, be performed by local motion (as is delivered, both in groſſe, and by detail, in our firſt Treatiſe) and that *Ariſtotle*, and all underſtanding Philoſophers do agree, there can be no local motion in an indiviſible thing (the reaſon whereof is evident, to whomſoever reflecteth upon the nature of *Place*, and of *local motion*) it is manifeſt, that there can be no motion to hurt the ſoul, ſince ſhe is concluded to be *indiviſible*.

6 The ſame is proved becauſe the ſoul hath no contrary.

The common argument likewiſe uſed in this matter, amounteth to the ſame effect: to wit, that ſince things are deſtroyed only by their contraries; that thing which hath no contrary, is not ſubject to deſtruction: (which Principle both Reaſon and experience, do every where confirme:) but a humane ſoul is not ſubject to contrariety: and therefore ſuch an one cannot be deſtroyed.

ſtroyed. The truth of the aſſumption, may be known two waies: firſt, becauſe all the contrarieties that are found within our cogniſance, do riſe out of the primary oppoſition of *Rarity*, and *Denſity*; from which the ſoul being abſolutely free, ſhe likewiſe is ſo, from all that groweth out of that roote: and ſecondly, we may be ſure, that our ſoul can receive no harm from contrariety; ſince all contraries are ſo far from hurting her, as contrarywiſe, the one helpeth her in the contemplation of the other: and as for contradiction in thoughts, which at different times our ſoul is capable of admitting, experience teacheth us, that ſuch thoughts do change in her, without any prejudice to her ſubſtance, they being accidents, and having their contrariety only betwixt themſelves within her, but no oppoſition at all to her; which only is the contrariety that may have power to harm her: and therefore, whatſoever of ſuch contrary thoughts be in the ſoul, pertaineth no more to her ſubſiſtence, than it doth to the ſubſiſtence of a body, whether it be here or there, on the right hand, or on the left.

7. The ſame is proved from the end for which the ſoul was created.

And thus I conceive my taske is performed; and that I am diſcharged of my undertaking to ſhew the ſouls *Immortality*, which importeth no more, than to ſhew, that the cauſes of other things mortality, do not reach her. Yet being well perſwaded, that my Reader will not be offended with the addition of any new light, in this dark ſubject; I will ſtrive to diſcover (if it be poſſible) ſome poſitive proof, or gueſſe, out of the property and nature of the ſoul it ſelfe, why ſhe muſt remain, and enjoy another life after this. To this end let us caſt our eye back, upon what hath been already ſaid, concerning her nature. We found that *truth* is the natural perfection of Mans ſoul; and that ſhe cannot be aſſured of truth naturally, otherwiſe than by evidence: and therefore it is manifeſt, that evidence of truth, is the full compleat perfection, at which the Soul doth aim. We found alſo, that the ſoul is capable of an abſolute infinity of truth or evidence. To theſe two, we will adde only one thing more, which of it ſelf is paſt queſtion, and therefore needeth no proof; and then we will deduce our concluſion, and this is, that in a man his ſoul is a far nobler, and perfecter part of him, than his body: and therefore, by the rules of Nature and of Wiſdom, his body was made for his ſoul, and not his ſoul finally for his body.

Theſe grounds being thus layed, let us examine, whether our ſoul doth in this life arrive to the end ſhe was ordained for, or no: and if ſhe do not, then it muſt follow of neceſſity, that our body was made but for a paſſage, by which our ſoul ſhould be ferried over into that ſtate, where ſhe is to attain unto that end for which her nature is framed and fitted: the great skill, and artifice of Nature, ſhewing and aſſuring us that ſhe never faileth of compaſſing her end, even in her meaneſt works: and therefore without doubt would not break her courſe in her greateſt, wherefore *man* is abſolutely the head and chief, among all thoſe that we are acquainted with now, what the end is, unto which our ſoul doth aim, is evident; ſince the perfection of every thing, is the *end* for which it is made, the perfection then, and end of the ſoul being *evidence*, and ſhe being capable of infinite *evidence*; let us enquire, whether in this life ſhe may compaſs it or no. To determine this queſtion, let us compare infinite *evidence*, to that *evidence*, which the greateſt and moſt knowing man that ever lived, hath acquired by the work of Nature alone; or to the evidence, which by aim we may imagine is poſſible ever to happen unto any one man to arrive unto: and balancing them well together, let us judge whether all that any man ca know here, is not in reſpect of what a mans ſoul is capable of, to be ſtiled as nothing, and deſerveth not the name of *evidence*, nor to be accounted of that nature: and if our ſentence do conclude upon this, let us acknowledge that our ſoul arriveth not to her perfection, nor enjoyeth her end in this world, and therefore, muſt have infallibly another habitation in the next world, unto which Nature doth intend her. Experience teacheth us, that we cannot fully comprehend any one of Natures works: and thoſe Philoſophers, who in a diſciplinable way ſearch into Nature, (and therefore are called Mathematicians) after they have written large volumes of ſome very ſlender ſubject, do ever finde, that they have left untouched, an endleſs abiſs of knowledge, for whomſoever ſhall pleaſe to build upon their foundations, and that they can never arrive near ſaying all that may be ſaid of that ſubject, though they have ſaid never ſo much of it. We may not then make difficulty to believe, that the wiſeſt and learnedſt men in the world, have reaſon to profeſs with the father of Philoſophers, that indeed they know nothing. And if ſo, how far are they

they from that happines and perfection, which consisteth in knowing all things? Of which full sea, we nevertheless finde even in this low ebbe, that our soul is a channel capable, and is framed a fit vessel and instrument to receive it, when the tide shall come in upon it, which we are sure it cannot do, until the banks of our body which hinder it, be broken down.

This last consideration, without doubt, hath added no small corroboration to our former proofs; which are so numerous and so clear, as peradventure it may appear superfluous to say any more to this point; since one convincing argument establisheth the verity of a conclusion, as efficaciously as a hundred, and therefore Mathematicians use but one single proof in all their Propositions, after which other supernumerary ones would be but tedious; nevertheles, since all the several ways, by which we may look into the nature of our soul (the importantest subject we can busie our thoughts upon) cannot fail of being pleasing and delightfull to us, we must not omit to reflect a little upon that great property of our soul, by which she is able to move and to work, without her self being moved or touched. Unto which adding, that all Life consisteth in motion, and that all motion of bodies cometh from some other thing without them; we may evidently conclude, that our soul, who can move without receiving her motion from a broad, hath in her self a spring of life; for the which she is not beholding (as Bodies are) to some extrinsecal cause of a nature like unto her; but only to him, who gave her to be what she is. But if she have such a spring of life within her, it were unreasonable to imagine, that she died upon the occasion of the death of another thing, that exerciseth no action of life, but as it is caused by another.

8. The same is proved because she can move without being moved.

Neither may we neglect that ordinary consideration, which taketh notice, that our soul maketh use of Propositions of eternal truth, which we have above produced, among our proofs for her being of a spiritual nature; and shall now employ it for the proving her *immortal:* by considering, that the notion of *being*, which setleth these Propositions so, as they fear no mutation or shaking by time, is the very root of the soul, and that which giveth her her nature, and which sheweth it self in all her operations: so that, if from being, arriveth unto these Propositions to fear no time, the like must of necessity betide also the sub-

9. The same is proved from her manner of operation which is grounded in *being*.

ſtance of the ſoul. And thus we ſee, that her nature is out of the reach of time: that ſhe can comprehend time, and ſet it limits, and that ſhe can think of things beyond it, and caſt about for them. All which are clear teſtimonies, that ſhe is free and ſecure from the all-devouring and deſtroying tyranny of that Saturnial Conqueror of the whole world of matter and of bodies, whoſe ſervant is death.

10. Laſtly it is proved from the ſcience of Morality, the principles wherof would be deſtroyed if the ſoul were mortal.

After all theſe proofs drawn from the nature of the ſoul it ſelf, every one of them of force to convince her immortality, I muſt crave leave to add one conſideration more, though it ſeemeth to belong unto anothers harveſt, namely to the ſcience of Morals: and it is, that the poſition of mortality in the ſoul, taketh away all morality, and changeth men into beaſts; by taking away the ground of all difference in thoſe things, which are to govern our actions. For ſuppoſing that the ſoul dieth with the body; and ſeeing that man hath a comprehenſion or notion of time without end; it is evident, that the ſpan of this life, muſt needs appear contemptible unto him that well conſidereth and weigheth it againſt the other infinite duration: and by conſequence, all the goods, and evils which are parts of this life, muſt needs become as deſpicable and inconſiderable: ſo that better or worſe in this life, hath not any appearance of difference between them; at the leaſt, not enough to make him labour with pain to compaſs the one, and eſchew the other, and for that end, to croſs his preſent inclination in any thing, and engage himſelf in any the leaſt difficult task: and ſo it would enſue, that if to an underſtanding man, ſome courſe or action were propoſed unto him, as better than that he were going about, or for the inſtant had a minde unto, he would reliſh it, as a great Merchant, or a Banquier would do, who dealing for Millions, one ſhould preſs him with earneſtneſs, to make him change his reſolved courſe, for the gain of a farthing more this way than the other; which being inconſiderable, he would not trouble his head with it, nor ſtop at what he was in hand with. In like manner, whoſoever is perſwaded that for an infinite of time he ſhall be *nothing*, and without ſenſe of all things, he ſcorneth for this little twinkling of his life, to take any preſent pains to be in the next moment well, or to avoid being ill; ſince in this caſe, dying is a ſecure remedy to any preſent evil; and he is as ready to die now, as a hundred years hence; nor can he eſteem

esteem the loss of a hundred years to be a matter of moment: and therefore he will, without any farther guidance or discourse betake himself to do whatsoever his present inclination beateth him to with most facility; upon this resolution, that if any thing cross him, he will presently forgo his life, as a trifle not worth the keeping: and thus, neither vertue, nor honour, nor more pleasure than what at the present tickleth him, doth fall into his account: which is the overthrow of the whole body of *Morality*, that is of mans action and nature. But all they who look into sciences, do cross that for an erroneous and absurd Position, which taketh away the Principles of any Science: and consequently, the Position of the souls *Mortality*, is to be esteemed such. There remaineth yet one consideration more, and peradventure more important, than any we have yet mentioned, to convince the souls immortality: which is, that spiritual things are in a state of *being*. But we shall not be able to declare this until we have proceeded a little farther.

CHAP. X.

Declaring what the soul of a man, separated from his body, is: and of her knowledge and manner of working.

UNhappy man! how long wilt thou be inquisitive and curious to thine own peril? Hast thou not already payed too dear for thy knowing more than thy share? Or hast thou not heard, that who will pry into Majesty, shall be oppressed by the glory of it? Some are so curious (shall I say) or so ignorant, as to demand what a humane soul will be, after she is delivered from her body; and unless they may see a picture of her, and have whereby to fansie her, they will not be perswaded, but that all are dreams, which our former discourses have concluded: as if he, who findeth himself dazeled with looking upon the Sun, had reason to complain of that glorious body, and not of his own weak eyes, that cannot entertain so resplendent a light.

1. That the soul is one simple knowing act which is a pure substance and nothing but substance.

Wherefore to frame some conceit of a separated soul, I will endeavour for their satisfaction to say somewhat of her future state. Let us then first consider what a thought is (I do not mean, that corporal spirit, which beateth at our common sense; but that

which is within, in the inward ſoul, whoſe nature we finde by diſcourſe and effects, though we cannot ſee it in it ſelf.) To this purpoſe we may obſerve, that if we are to diſcourſe, or to do any thing, we are guided the right way in that ſubject we have in hand, by a multitude of particular thoughts; which are all of them terminated in that diſcourſe or action: and conſequently every act of our minde, is as it were an actual rule or direction, for ſome part of ſuch diſcourſe or action: ſo that we may conceive a compleat thought (compounded of many particular ones) to be a thing that ordereth one entire diſcourſe or action of our life.

A thought being thus deſcribed, let us in the next place try, if we can make an apprehenſion, what a *Science* or an *Art* is: as, what the *Science* of *Aſtronomy* is; or what the art of playing on the *Organs* is, when the Aſtronomer thinketh not of the motions of the Heavens, nor the Organiſt of playing on his Inſtrument: which Science and Art do nevertheleſs even then reſide in the Aſtronomer, and in the Organiſt: and we finde, that theſe are but the reſults of many former compleat thoughts; as being thoſe very thoughts in remainder, whatſoever this may ſignifie.

Laſtly, Let us conceive (if we can) a *power* or *capacity* to *being*: Unto which capacity, if any *being* be brought, that it is unſeparably glewed and riveted unto it, by its very being a *being*: and if any two things be brought unto it by the vertue of one *being*, common to both thoſe things, that both of them, by this one *being*, do become one betwixt themſelves, and with this *capacity*; and that ſo there is no end or period of this addition of things, by the mediation of *being*; but that by links and rings, all the things that are in the world, may hang together betwixt themſelves, and to this power; if all of them may be brought unto it by the Glew and vertue of *being*: in ſuch ſort as we have formerly declared, paſſeth in the Soul.

Now let us put this together, and make up ſuch a thing, as groweth out of the capacity to *being* thus actuated, and cleaving to all things that any way have *being*: and we ſhall ſee, that it becometh a whole entire world, ordered and clinging together with a great ſtrength and neceſſity, as can proceed from the nature of *being*, and of *contradiction*: and our reaſon will tell us, that

that such a thing, if it be active, can frame a world, such a one as we live in, and are a small parcell of, if it have matter to work upon; and can order whatsoever hath *being*, any way that it is capable of being ordered, to do by it, and to make of it, whatsoever can be done by, and made of such matter.

All these conceptions (especially by the assistance of the last) may serve a little to shadow out a perfect soul, which is, *a knowledge, an art, a rule, a direction of all things*: and all this by being all things in a degree and strain, proper and peculiar to it self: and an unperfect soul, is a participation of this Idea: that is, a knowledge, a rule, and a direction, for as much as it is, and as it attaineth unto. Now as in our thoughts it is the corporeal part onely which maketh a noise, and a shew outwardly, but the spiritual thought is no otherwise perceived than in its effect, in ordering the bodily acts; in like sort, we must not conceive this knowledge to be a *motion*; but meerly to be a *thing* or *being*, out of which the ordering and moving of other things doth flow, it self remaining fixed and immovable; and because all that is joyned unto it, is there riveted by *being*, or *identification*; and that when one thing is another, the other is again it; it is impossible that one should exceed the other, and be any thing that is not it: and therefore, in the soul there can be no parts, no accidents, no additions, no appendances, nothing that sticketh to it, and is not it: but whatsoever is in her, is *soul*, and the soul is all that which is within her; so that all that is of her, and all that belongeth unto her is nothing but one pure simple substance, peradventure Metaphysically, or formally divisible; (in such sort as we have explicated in the first Treatise of the divisibility between quantity and substance) but not quantitatively, as bodies are divisible. In fine, substance it is, and nothing but substance; all that is in it, being joyned and imped into it by the very nature of *being*, which maketh substance. This then, is the substantial conceit of a humane soul stripped of her body.

2. That a separated soul is in no place, and yet is not absent from any place.

Now, to conceive what proprieties this substance is furnished with; let us reflect upon the notions we frame of things, when we consider them in common: as when we think of a man, of bread, of some particular vertue, of a vice, or of whatsoever else, and let us note, how in such, our discourse determineth no *place*, nor *time*; nay, if it should, it would mar the discourse; as Logicians shew, when

when they teach us, that ſcientifical ſyllogiſms cannot be made without univerſal propoſitions: ſo that we ſee, unleſs theſe things be ſtripped from *Place* and *Time*, they are not according to our meaning: and yet nevertheleſs, we give them both the name and the nature of a *Thing*, or of a *ſubſtance*, or of a *living thing*, or of whatſoever elſe may by our manner of conceiving or endeavours, be freed from the ſubjection of *time* and *place*. Thus then we plainly ſee, that it is a very different thing, *to be*, and *to be in a place*: and therefore, out of a *Things being in no place*, it cannot be inferred, *That it is not*, or *that it is no ſubſtance*: nor contrariwiſe, out *of its being*, can it be inferred, *that it is in a place*: there is no man but of himſelf perceiveth the falſe conſequence of this argument, a thing is, therefore it is hot, or it is cold: and the reaſon is, becauſe hot and cold, are particular accidents of a body; and therefore a body can be without either of them. The like proportion is between *Being* in general, and *Being a Body*, or *Being in a Body*: for both theſe, are particular in reſpect of *Being*: but *to be in a place*, is nothing elſe, but *to be in a circumſtant Body*: and ſo what is not in a Body, is not in a Place: therefore, as it were an abſurd illation to ſay, *it is*, therefore it is in a Body; no leſs is it to ſay, *it is*, therefore *it is ſomewhere*; which is equivalent to, *in ſome Body*: and ſo a great Maſter (Peradventure one of the greateſt, and judiciouſeſt that ever have been) telleth us plainly, that of it ſelf it is evident, to thoſe who are truly learned, that *incorporeal ſubſtances are not in Place*. and *Ariſtotle* teacheth us, *that the Univerſe is not in Place*.

But now to make uſe of this diſcourſe, we muſt intimate what it is we level at in it: we direct it to two ends; firſt, to lead on our thoughts, and to help our apprehenſion, in framing ſome conception of a ſpiritual ſubſtance, without reſidence in *Place*, and to prevent our fanſies checking at ſuch abſtraction; ſince we ſee that we uſe it in our ordinary ſpeech, when we think not on it, nor labour for it, in all univerſal and indefinite terms: next to trace out an eminent propriety of a ſeparated ſoul: namely, that ſhe is no where; and (yet upon the matter) that ſhe is every where: that ſhe is bound to no place, and yet remote from none: that ſhe is able to work upon all, without ſhifting from one to another, or coming near any: and that ſhe is free from all, without removing or parting from any one.

A second propriety, not much unlike the first, we shall discover in a separated soul, if we compare her with *time*. We have heretofore explicated, how *time* is the motion of the heavens; which giveth us our motion; which measureth all particular motions; and which comprehendeth all bodies, and maketh them await his leisure. From the large Empire of this proud Commander, a separated soul is free: For although she do consist with time, (that is to say, she is, whiles time is;) yet is she not in time; nor doth she in any of her actions, expect time; but she is able to frame time, to spin or weave it out of her self, and to master it. 3. That a separated soul is not in time nor subject to it.

All which will appear manifestly, if we consider what it is *to be in time*. *Aristotle* sheweth us; that, *to be comprehended under time*, or *to be in time*, is, to be one of those moveables, whose *being* consisting in motion, taketh up but a part of time; and hath its terms, before, and behind, in *time*; and is measured by *time*; and must expect the flowing of *Time*, both for *being*, and for *action*. Now all this manifestly belongeth unto bodies, whose both *action* and *being*, is subject to a perpetual local motion and alteration: and consequently, a separated soul, who is totally a *being*, and hath her whole operation all together (as being nothing but her self when we speak of her perfective operation;) cannot be said to be in time, but is absolutely free from it; though time do glide by her, as it doth by other things: and so, all that she knoweth or can do, she doeth and knoweth at once, with one act of the understanding; or rather, *She* is, (indeed and really) *all that*: and therefore she doth not require time to manage, or order her thoughts, nor do they succeed one another, by such vicissitudes as men are forced to think of things by, because their fansie, and the images in it which beat upon the soul to make her think, whiles she is in the body, are corporal, and therefore do require time to move in, and to give way to one another: but she thinketh of all the things in the world, and of all that she can think of, together and at once; as hereafter we intend to shew.

4. That the soul is an active substance, and all in it is activity.

A third propriety we may conceive to be in a separated soul, by apprehending her to be *an Activity*; which that we may rightly understand, let us compare her in regard of working, with a body: reflecting then upon the nature of bodies, we shall find, that

that not any of them will do the functions they are framed for, unleſs ſome other thing do ſtir them up, and cauſe them ſo to do. As for example; a knife, if it be thruſt or preſſed, will cut, otherwiſe, it will lie ſtill and have no effect: and as it fareth with a knife, ſo it doth in the ſame manner with thoſe bodies, which ſeem moſt to move themſelves; as upon a little conſideration, will appear plainly. A beaſt ſeemeth to move it ſelf: but if we call to minde, what we have delivered upon this ſubject in the firſt Treatiſe, we ſhall finde, that whenſoever he beginneth to move, he either perceiveth ſomething by his ſenſe, which cauſeth his motion, or elſe he remembreth ſomething that is in his brain, which worketh the like effect. Now if ſenſe preſenteth him an object that cauſeth his motion, we ſee manifeſtly, that it is an external cauſe which maketh him move: but if memory do it, we ſhall finde that ſtirred by ſome other part; as by the ſtomack, or by the heart, which is empty, or heated, or hath received ſome other impreſſion from another body, ſo that, ſooner or later, we ſhall diſcover an outward mover. The like is in natural motions; as, in heavie things, their eaſie following (if they be ſucked) another way than downwards, teſtifieth that their motion downwards hath an extrinſecal motor, as is before declared: and not onely in theſe, but throughout, in all other corporal things. So that in a word, all bodies are of this nature, that unleſs ſome other thing preſs them and alter them, when they are quiet, they remain ſo; and have no activity, otherwiſe than from an extrinſecal mover: but of the ſoul, we have declared the contrary; and that, by its nature, motion may proceed from it, without any mutation in it, or without its receiving any order, direction, or impulſe, from an extrinſecal cauſe.

5. A Deſcription of the ſoul.

So that now ſumming up together all we have ſaid upon this occaſion, we finde a ſoul exempted from the body, to be, *An indiviſible ſubſtance, exempted from place and time, yet preſent to both: an actual and preſent knowledge of all things that may be known: and a skill or rule, even by what it ſelf is, to all things whatſoever.* This ſhe is, if ſhe be perfect: but if ſhe be imperfect, then is ſhe all this to the proportion of her growth, (if ſo I may ſay) and ſhe is powerfull according to the meaſure of her knowledge, and of her will. So that in fine, a ſeparated ſoul, is of a nature to have, and to know, and to govern all things.

I may

I may reasonably suspect, that my saying how imperfect souls are rules *to the proportion of their growth*, may have occasioned great reflection, and may have bred some trouble in the curious and heedful Reader. I confesse this expression was delivered by me, only to free my self for the present from the labour of shewing what knowledge every seperated soul hath: but upon second thoughts, I finde that such sliding over this difficult point will not serve my turn, nor save me the pains of untying this knot: for unlesse I explicate what I mean by that speech, I shall leave my Reader in great doubt and anxiety; which to free him from, I must wade a little farther in this question *of the extent of a seperated souls knowledge*, into which, I have thus, upon the by, engaged my selfe: but let him first be advertised, that I do not here meddle, with what a separated soul may know by revelation, or by supernatural means: but that I do only track out her natural paths; and do guesse at what she is, or knoweth, by that light which her conversation in her body affordeth us.

6. That a seperated soul knoweth all that which she knew whilst she was in her body.

Our entrance into this matter must be, to consider what mutation in respect of knowledge, a souls first change out of her body, maketh in her; for it is not unlikely, but that Nature may one way enlighten us so far, as to let us understand what must follow out of the negation of the bodies consortship, added unto what we know of her and other works in this world. This then first occurreth that surely she cannot choose but still know in that state, all that she did know whilest she was in the body; since we are certain that the body hath no part in that which is true knowledge: as is above declared, when we shewed; first, that all true knowledge is respective; secondly, that the first impressions of the fansie, do not reach to the interiour soul; and lastly, that she worketh by much more, then what hath any actual correspondence in the fansie, and that all things are united to her by the force of *Being*: from which last, it followeth that all things she knoweth, *are her self*, and she *is*, *all that she knoweth*: wherefore, if she keepeth *her self* and her own *being*, she must needs keep the knowledge of all that she knew in this world.

Next

7. That the least knowledge which the soul acquireth in her body of any one thing doth cause in her, when she is seperated from her body a compleat knowledge of all things whatsoever.

Next, she must undoubtedly know then somewhat more, then she knew in the body; for seeing that out of the things she already knoweth, others will follow by the meer ordering and connexion of them; and that the souls proper work, *is to order things*: we cannot doubt, but that, both the things she knoweth in this world, must of necessity be ordered in her to the best advantage; and likewise, that all that, will be known, which wanteth no other cause for the knowing of it, but the ordering of these things: For if the nature of a thing, were *Order*, who can doubt but what were put in to that thing, were put into *Order*? Now, that the nature of the soul is such, we collect easily; for seeing that all order proceedeth from her, it must be acknowledged that *Order* is first in her: but what is in her, is her nature, her nature then is *Order*, and what is in her is ordered. In saying of which, I do not mean, that there is such an order between the notions of a seperated soul, as is between material things, that are ordered by the soul whiles she is in the body; so seeing that the soul adæquate cause of such order; (that is to say a cause which can make any an such, and the whole kinde of it;) it followeth, that such order is not in her; for if it were she, would because of her self, or of her own parts. Order therefore, in her, must signifie a thing more eminent, than such inferiour order, in which resideth the power of making that inferiour *Order*; and this is nothing else, but the connexion of her notions by the necessity of *being*; which we have often explicated. And out for this eminent or superiour kinde of order, our conclusion followeth no lesse than if the inferiour order which we see in our fansies, whiles our soul is in our body, did reside in our interiour soul; for, it is the necessity of identification, which doth the effect, and maketh the soul know; and the order of fantasms, is but a precedent condition in the bodily agent, that it may work upon the soul; and if more fantasms than one could be together, this *order* would not be necessary.

Out of this, a notable and a vast conclusion, manifestly followeth: to wit, that if a soul, can konw any one thing more when she is out the *body*, then what she did know whiles she was in the body; without any manner of doubt, she knoweth all that can

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be drawn, and forced out of those knowledges, which she had in her body. How much this is, and how far it will reach, I am afraid to speak: only I entreat Mathematicians, and such as are acquainted with the manner how Sciences proceed; to consider how some of their definitions are made: to wit, by composing together sundry known terms, and giving a new name to the compound that resulteth out of them: wherefore clear it is, that out of fewer notions had at the first, the soul can make many more, and the more she hath, or maketh, the more she can multiply. Again, the maximies, which are necessary to be added unto the definitions for gaining of knowledge, we see are also compounded of ordinary and known terms; so that a seperated soul, can want neither the Definitions, nor the Maximies, out of which the books of Sciences are composed: and therefore, neither can the Sciences themselves be wanting unto her. Now if we consider, that in the same fashion as demonstrations are made, and knowledge is acquired in one Science, by the same means, there is a transcendence from Science to Science: and that there is a connexion among all the Sciences, which fall into the consideration of man, and indeed among all, at the least corporal things; (for of spiritual things, we cannot so assuredly affirm it; although their perfection may perswade us, that there is rather a greater connexion among them, than among corporal things) it will follow, that a soul which hath but any indifferent knowledge in this world, shall be replenished with all knowledge in the next.

But how much is this indifferent knowledge, that for this purpose is required in this world? Upon mature consideration of this point, it is true, I finde it absolutely necessary, that the soul must have here so much knowledge, as to be able to determine that some one thing, which hath connexion with all the rest, is in such a time: but then, why out of this very conception, she should not be able to climb up by degrees, to the knowledge of all other things whatsoever (since there is a connexion between that, and all the rest, and no untransible gappe, or Chaos to sever them) I professe I do not see. Which if it be so, then the soul of an abortive in his mothers Womb, if he once arrive to have sense, and from it, to receive any impression in his soul, may for ought

ought I know, or can ſuſpect to the contrary, be endewed in the next world with as much knowledge, as the ſoul of the greateſt Clerk that ever lived: and if an abortive do not arrive ſo far, as to the knowledge of ſome one thing, I know no reaſon, why we ſhould believe it arrived to the nature of man.

Whence it followeth, that this amplitude of knowledge, is common to all humane ſouls, (of what pitch ſoever they ſeem to be here) when they are ſeperated from their bodies: as alſo, that if any errour have crept into a mans judgement, during this life, whether it be of ſome univerſal concluſion, or of ſome particular thing, all ſuch will be aboliſhed then, by the truth appearing on the oppoſite ſide; ſithence two contradictory judgements, cannot poſſeſſe our ſoul together: as even in this world as well experience, as reaſon teacheth us.

An anſwer to the objections of ſome Peripatetikes who maintain the ſoul to periſh with the body.

8. But unawares I have engulfed my ſelf into a ſea of contradiction, from no mean adverſaries: for *Alexander*, *Aphrodiſeus Pomponatius* and the learnedſt of the Peripatetick School, will all of them riſe up in main oppoſition againſt this doctrine of mine: ſhewing how in the body, all our ſouls knowledge is made, by the working of our fantſie; and that there is no act of our ſoul, without ſpeculation of fantaſms reſiding in our memory: therefore, ſeeing that when our body is gone, all thoſe little bodies of fantaſms are gone with it; what ſign is there, that any operation can remain? And hence they infer, that ſeeing every ſubſtance hath its *Being* for its operations ſake, and by conſequence were vain and ſuperfluous in the world, if it could not enjoy and exerciſe its operation; there is no neceſſity or end, why the ſoul of a man ſhould ſurvive his body: and conſequently, there is no reaſon to imagine other, than that it periſheth when the man dieth. This is the ſubſtance of their Argument; which indeed is nothing elſe, but to gueſſe without ground, or rather againſt all ground: but howſoever, this comfort I have, that I have to do with Peripatetikes; men that will hear and anſwer reaſon: and to ſuch I addreſſe my ſpeech.

To joyn iſſue then with them, and to encounter them with their own weapons, let us call to minde, what *Ariſtotle* holdeth light to be. He ſaith, *That it is a ſuddain and momentary ema-*

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nation of what it is, following the precedent motion of some body, but without motion in it self. As for example: when the Sun commeth into our horiſon, (ſaith he) the illumination of the Horiſon, is an effect in an inſtant, following from the motion which the Sun had, ſince his ſetting in the other Hemiſphere, untill he appear there againe: ſo that (according to him) the way of making this light, is the Sunnes local motion; but the effect or the *being enlightned*, is a thing of a very different nature, done without beginning, and continuing untill the Sunne depart againe from our Horiſon. And as he explicateth this action of illuminatton, in the ſame manner, doth he the actions of ſenſe and of underſtanding. Upon all which I urge, that no Peripatetick will deny me, but that as in every particular ſenſation or thinking, there proceedeth a Corporall motion, out of which it enſueth, ſo this generall motion, which we call *the life of man*, precedeth that twinkle or moment, in which ſhe becommeth an abſolute ſpirit, or inhabitant of the next world. Wherefore it cannot bee ſaid, that we introduce a doctrine alien from the Peripatetick way of Philoſophiſing, if wee put a momentary effect or motion (according to their phraſe of ſpeaking) to follow out of the courſe of mans life; ſince they put diverſe ſuch effects, to follow out of particular parts of it.

Now, this momentary change, or what they pleaſe to call it, is that which maketh at one blow, all this knowledge we ſpeak of: for, if we remember that knowledge is not a *doing* or a *motion*, but a *Being*; as is agreed between the Peripateticks and us; they cannot, for the continuing it, require inſtruments and motors: for they are neceſſary onely for change, not for *being*. Now, all this mighty change, which is made at the ſoules delivery, we conceive followeth preciſely out of the change of her *Being*: for ſeeing it is ſuppoſed, that her *Being* was before in a body, but is now out of a body; it muſt of neceſſity follow, that all impediments, which grew out of her being in a body, muſt be taken away by her being freed from it. Among which impediments, one is, that time is then required betwixt her

knowledge of one thing, and her knowledge of an other thing; and ſo her capacity, that of it ſelf is infinite, becometh confined to that ſmall multitude of objects, which the diviſion and ſtraightneſſe of time giveth way unto. Now that, which length of time could in part work in the body, the ſame is entirely done in a moment, by the changing of her manner of *being*: for by taking away the bonds, by which ſhe was enthralled in the body, and was kept in, to apprehend but according to the meaſure of the body, and was conſtrained to be, and to enjoy her ſelf (as it were) but at the bodies permiſſion; ſhe is put in free poſſeſſion of her ſelf, and of all that is in her. And this is nothing elſe, but to have that large knowledge, we have ſpoken of, for her knowing all that, is no other thing but her being her ſelfe perfectly. Which will appear evident, if we conſider that her nature is, *to be a Knower*, and that Knowledge is nothing elſe but a *Being of the object in the Knower*; for thence it followeth, that to know all things is nought elſe than to be all things: ſince then, we concluded by our former diſcourſe, that all things were to be gathered out of any one; it is clear, that to be perfectly her ſelf, and any one thing, is in truth to know all things.

And thus we ſee, that for the ſoules enjoyning all this knowledge when ſhe is out of the body, ſhe needeth no objects without her, no phantaſmes, no inſtruments, no helps; but that all that is requiſite, is contained abſolutely in her being her ſelf perfectly. And ſo we retort our Adverſaries Objection on themſelves; by repreſenting to them, that ſince in their own doctrine, they require no body nor inſtruments for that preciſe action which they call underſtanding: it is without all ground, for them to require bodies and inſtruments in the next life, that the ſoul may there be that, which they acknowledge ſhe is in her body without any ſuch helps.

And as for that *Axiome* or experience, *that the Soul doth not underſtand, unleſſe ſhe ſpeculate phantaſmes*: as on the one ſide I yield to it, and confeſſe the experience, after the beſt and ſerioſeſt tryall I could make of it; ſo on the other

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ſide, when I examine the matter to the bottom, I finde that it commeth not home to our adverſaries intention. For as when we look upon a thing, we conceive we work upon that thing, whereas in truth we do but ſet our ſelves in ſuch a poſition that the thing ſeen may work upon us: in like manner our looking upon the phantaſmes in our brain; is not our ſouls action upon them, but it is our letting them beat at our common ſenſe; that is, our letting them work upon our ſoul. The effect whereof is, that either our ſoul is bettered in her ſelf, as when we ſtudy and contemplate: or elſe, that ſhe bettereth ſomething without us, as when by this thinking, we order any action.

But, if they will have this *Axiome* avail them, they ſhould ſhew that the ſoul is not of her ſelf a knowledge; which if they be able to do, even then when to our thinking, ſhe ſeemeth not ſo much as to think, we will yield they have reaſon: but that will be impoſſible to them to do; for ſhe is alwaies, of her ſelf, a knowledge, though in the body ſhe never expreſſeth ſo much, but when ſhe is put to it. Or elſe they ſhould ſhew, that this knowledge which the ſoul is of her ſelf, will not by changing the manner of her *Exiſtence*, become an actual knowledge, inſtead of the habitual knowledge which now appeareth in her.

But as theſe Ariſtotelians embrace and ſticke to one *Axiome* of their Patron; ſo they forego and prevaricate againſt an other: for as it is *Ariſtotles* Doctrine, that a ſubſtance is for its operation, and were in vain and ſuperfluous if it could not practiſe it; ſo likewiſe it is confeſſed doctrine, that *Matter* is for its *form*, and not the *form* for the *matter*. And yet theſe men pretend, that the ſoul ſerveth for nothing but the governing of the body: whereas contrariwiſe, both all *Ariſtotles* Doctrine, and common ſenſe convinceth, that the body muſt be for the ſoul. Which if it be, nothing can be more conſentaneous to Reaſon, than to conceive that the durance which the ſoul hath in the body, is aſſigned her, to work and mould in her the future ſtate, which ſhe is to have after this life: and that no more operations are to be expected from her

9. The former Peripatetikes refuted out of *Ariſtotle*.

after this life, but instead of them, a settled state of *Being*, seeing that, even in this life, according to *Aristotles* doctrine, the proper operations of the soul are but certain *Beings*: so that we may conclude, that if a soul were grown to the perfection, which her nature is capable of, she would be nothing else but a constant *Being*, never changing from the happiness of the best *Being*.

And although the texts of *Aristotle* which remain unto us, be uncertain (peradventure, not so much because they were originally such, in themselves, as through the mingling of some comments into the body of the text;) yet if we had his book which he wrote of the soul upon the death of his friend *Eudemus*, it is very likely we should there see his evident assertion of her *Immortality*; since it had been very impertinent to take occasion upon a friends death to write of the soul, if he intended to conclude, that of a dead man there were no soul.

10. The operations of a separated Soul compared to her operations in her body.

Out of this discourse it appeareth, how those Actions which we exercise in this life, are to be understood, when we hear them attributed to the next: for to think that they are to be taken in their direct plaine meaning, and in that way, in which they are performed in this World, were a great simplicity, and were to imagine a likenesse between bodies and spirits; we must therefore elevate our minds, when we would penetrate into the true meaning of such expressions, and consider how all the actions of our soule are eminently comprehended in the universality of knowledge, we have already explicated. And so, the Apprehensions, Judgements, Discourses, Reflections, Talkings together, and all other such actions of ours, when they are attributed to separated souls, are but inadæquate names and representations of their instantaneall sight of all things, for, in that, they cannot choose but see others mindes, which is that we call talking, and likewise their own, which we call reflection: the rest are plain parts, and are plainly contained in knowledge: discourse being but the falling into it; judgement the principle of it; and single apprehensions the components of judgements:

then

then for ſuch actions as are the beginning of operation, there can be no doubt but that they are likewiſe to be found, and are reſumed, in the ſame Univerſality; as, love of good, conſultation, reſolution, prudential election, and the firſt motion; for who knoweth all things, cannot chooſe but know what is good, and that good is to be proſecuted: and who ſeeth compleatly all the means of effecting and attaining to his intended good, hath already conſulted and reſolved of the beſt: and who underſtandeth perfectly the matter he is to work upon, hath already made his prudential election: ſo that there remaineth nothing more to be done, but to give the firſt impulſe.

And thus you ſee, that this Univerſality of Knowledge in the ſoul, comprehendeth all, is all, performeth all; and no imaginable good or happineſs, is out of her reach. A noble creature, and not to be caſt away upon ſuch traſh as moſt men employ their thoughts in. Upon whom it is now time to reflect, and to conſider, what effects the divers manners of living in this world, do work upon her in the next; if firſt we acquit our ſelves of a promiſe we made at the end of the laſt Chapter. For it being now amply declared, that the ſtate of a Soul exempted from her body, is a ſtate of pure *being*; it followeth manifeſtly, that there is neither action nor paſſion in that ſtate: which being ſo, it is beyond all oppoſition that the ſoul cannot die: for it is evident, that all corruption muſt come from the action of another thing, upon that which is corrupted; and therefore that thing muſt be capable of *being* made better, and of being made worſe. Now then, if a ſeparated ſoul be in a final ſtate, where ſhe can neither be bettered, or worſened, (as ſhe muſt be, if ſhe be ſuch a thing as we have declared) it followeth, that ſhe cannot poſſibly loſe the *Being* which ſhe hath: and ſithence her paſſage out of the body, doth not change her nature, but onely her ſtate; it is clear, that ſhe is of the ſame nature even in the body: though in this her durance, ſhe be ſubject to be forged (as it were) by the hammers of corporeal objects beating upon her; yet ſo, that of her ſelf ſhe ſtill is what ſhe is. And therefore as ſoon as ſhe is out of the paſſible oore, in which ſhe ſuffereth by reaſon of that oore, ſhe preſently becommeth impaſſible, as *being* purely of her

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her own nature, a fixed ſubſtance, that is, a pure *being*. Both which ſtates of the ſoul, may in ſome ſort be adumbrated by what we ſee paſſeth in the coppelling of a fixed metal; for as long as any led, or droſſe, or allay remaineth with it, it continueth melted, flowing, and in motion under the muffle: but as ſoon as they are parted from it, and that it is become pure, without any mixture, and ſingly it ſelf; it contracteth it ſelf to a narrower room, and at that very inſtant, ceaſeth from all motion, groweth hard, permanent, reſiſtent unto all operations of fire, and ſuffereth no change or diminution in its ſubſtance by any outward violence we can uſe unto it.

CHAP. XI.

Shewing what effects, the divers manners of living in this world, do cauſe in a ſoul, after ſhe is ſeparated from her body.

1. That a ſoul in this life is ſubject to mutation, and may be perfected in knowledge.

ONe thing may peradventure ſeem of hard digeſtion in our paſt diſcourſe; and it is, that out of the grounds we have laid, it ſeemeth to follow, that all ſouls will have an equality; ſince we have concluded, that the greateſt ſhall ſee or know no more than the leaſt: & indeed, there appeareth no cauſe why this great & noble creature, ſhould ly impriſoned in the obſcure dungeon of noyſome fleſh; if in the firſt inſtant, in which it hath its firſt knowledge it hath then already gained all whatſoever it is capable of gaining in the whole progreſſe of a long life afterwards. Truly, the Platonick Philoſophers (who are perſwaded that a human ſoul doth not profit in this life, nor that ſhe acquired any knowledge here; as being of her ſelf compleatly perfect, and that all our diſcourſes, are but her remembrings of what ſhe had forgotten) will find themſelves ill beſted to render a Philoſophical & ſufficient cauſe of her being locked into a body: for to put forgetfulneſs in a pure ſpirit; ſo palpable an effect of corporeity, & ſo great a corruption, in reſpect of a creature whoſe nature is, to know of it ſelf, is an unſufferable error. Beſides, when they tell us, that ſhe cannot be changed, becauſe all change would prejudice the ſpiritual nature, which they attribute to her; but that well ſhe may be warned and exciated by being in a body;

body; they meerly trifle: for either there is some true mutation made in her by that which they call a warning, or there is not; if there be not, how becommeth it a warning to her? Or what is it more to her than if a straw were wagged at the Antipodes? But if there be some mutation (be it never so little) made in her by a corporeal motion; what should hinder, why she may not by means of her body, attain unto science she never had; as well as by it receive any the lest intrinsecall mutation whatsoever? For if once we admit any mutability in her from any corporeal motion, it is far more conformable unto reason to suppose it in regard of that which is her natural perfection, and of that, which by her operations we see she hath immediately after such corporeal motions, and whereof before them there appeared in her no marks at all; than to suppose it in regard of a dark intimation, of which we neither know it is, nor how it is performed. Surely, no Rational Philosopher seeing a thing, whose nature is to *know*, have a *being*, whereas formerly it existed not; and observing how that thing by little and little giveth signs of more and more knowledge, can doubt but that as she could be changed from not *being* to *being*; so, may she likewise be changed from lesse knowing, to more knowing.

2. That the knowleges which a soul getteth in this life will make her knowledge in the next life more perfect and firm.

This then being irrefragably settled, that in the body she doth encrease in knowledge: let us come to our difficulty, & examine what this encrease in the body availeth her; seeing that as soon as she parteth from it, she shall of her own nature enjoy, and be replenished with the knowledge of all things: why should she laboriously strive to anticipate the getting of a few drops which but encrease her thirst and anxiety; when having but a little patience, she shall at one full and everlasting draught drink up the whole sea of it? We know that the soul is a thing, made proportionably to the making of its body; seeing, it is the bodies compartner: and we have concluded, that whiles it is in the body, it acquireth perfection in that way, which the nature of it is capable of; that is, in knowledge: as the body acquireth perfection its way; which is, in strength and agility. Now then let us compare the proceedings of the one, with those of the other substance; and peradventure we may gain some light to discern what advantage it may prove unto a soul, to remain long

in its body; if it make right use of its dwelling there; Let us consider the body of a man, well and exactly shaped in all his members; yet if he never use care, nor pains to exercise those well-framed limbs of his, he will want much of those corporeal perfections which others will have, who employ them sedulously. Though his legs, arms, and hands, be of an exact symmetry, yet he will not be able to run, to wrestle, or to throw a dart, with those who labour to perfect themselves in such exercises: though his fingers be never so neatly moulded or composed to all advantages of quick and smart motion; yet if he never learned and practised on the Lute, he will not be able with them to make any musick upon that instrument, even after he seeth plainly, and comprehendeth fully all that the cunningest Lutenist doth; neither will he be able to play, as he doth with his fingers, which of themselves are peradventure lesse apt for those voluble motions than his are. That which maketh a man dexterous in any of these Arts, or in any other operation, proper to any of the parts or limbs of his body, is the often repetitions of the same Acts; which do amend, and perfect those limbs in their motions, and which make them fit and ready for the actions they are designed unto.

In the same manner it fareth with the soule; whose essence is that which she knoweth: her several knowledges may be compared, to arms, hands, fingers, legs, thighs, &c. in a body: and all her knowledges taken together, do compose (as I may say) and make her up, what she is. Now, those limbs of hers, though they be, when they are at the worst, entire, and well-shaped in bulk (to use the comparison of bodies) yet they are susceptible of farther perfection, as our corporeal limbs are, by often and orderly usage of them. When we iterate our acts of our understanding any object, the second act is of the same nature, as the first, the third as the second, and so of the rest: every one of which perfecteth the understanding of that thing, and of all that dependeth upon the knowledge of it, and maketh it become more vigorous and strong; even the often throwing of a bowl at the same mark, begetteth still more and more strength and suppleness in the Arm that delivereth it: for, it cannot be denyed

but

but that the ſame cauſe which maketh any thing, muſt of neceſſity perfect and ſtrengthen it, by repeating its force and ſtroaks. We may then conclude that the knowledge of our ſoul, (which is indeed her ſelf) will be in the next life more perfect and ſtrong, or more ſlack and weak, according as in this life ſhe hath often and vigorouſly, or faintly and ſeldom, buſied her ſelf about thoſe things which beget ſuch knowledge.

3. That the ſouls of men addicted to ſcience whilſt they lived here, are more perfect in the next world than the ſouls of unlearned men.

Now thoſe things which men beſtow their pains to know, we ſee are of two kinds: for ſome thirſt after the knowledge of nature, and of the variety of things, which either their ſenſes, or their diſcourſe, tell them of: but others look no higher than to have an inſight into humane action, or to gain skill in ſome Art, whereby they may acquire means to live. Theſe latter curioſities, are but of particulars; that is, of ſome one, or few ſpecies, or kindes, whoſe common that comprehendeth them, falleth within the reach of every vulgar capacity; and conſequently, the things which depend upon them, are low, mean, and contemptible: whereas the beauty, vaſtneſs, and excellency of the others, is ſo much beyond them, as they can be brought into no proportion to one another. Now then, if we conſider, what advantage the one ſort of theſe men, will in the next world have over the other, we ſhall finde, that they who ſpend their life here in the ſtudy and contemplation of the firſt noble objects, will, in the next, have their univerſal knowledge (that is their ſoul) ſtrong and perfect: whiles the others, that played away their thoughts and time upon trifles, and ſeldom raiſed their mindes above the pitch of ſenſe, will be faint through their former lazineſs, like bodies benummed with the palſey, and ſickly through their ill dyet, as when a well-ſhaped virgin, that having fed upon traſh inſtead of nouriſhing meats, languiſheth under a wearieſome burthen of the green-ſickneſs.

4. That thoſe ſouls which embrace vertue in this world will be moſt perfect in the next, and thoſe which embrace vice moſt miſerable.

To make this point yet more clear, we may conſider how the things which we gain knowledge of, do affect us under the title of good and convenient, in two ſeveral manners. The one is, when the appearance of good, in the abſtracted nature of it, & after examination of all circumſtances, carryeth our

our heart to the desire of the thing, that appeareth so unto us: the other is, when the semblance of good to our own particular persons without casting any further, or questioning whether any other regard may not make it prejudicial, doth cause in us a longing for the thing wherein such semblance shineth. Now for the most part the knowledges which spring out of the latter objects, are more cultivated by us, than those which arise out of the other; partly by reason of their frequent occurring, either through necessity, or through judgement; and partly, by the addition which passion giveth to the impressions they make upon us? for passion multiplyeth the thoughts of such things, more than of any others, if reason do not crosse and suppresse her tumultuary motions, which in most men, she doth not. The souls then of such persons, as giving way to their passion, do in this life busie themselves about such things as appear good to their own persons, and cast no farther, must needs decede from their bodies, unequally builded, (if that expression may be permitted me;) and will be like a lame unwieldy body, in which the principall limbs, are not able to govern and move the others; because those principall ones are faint, through want of spirits and exercise; and the others are overgrown with hydropical and nocive humours. The reason whereof is, that in such souls their judgements will be disproportioned to one another, one of them being unduely stronger than the other. What effect this worketh, in regard of knowledge, we have already declared, and no lesse will it have in respect of action: for suppose two judgements to be unequal, and such, as in the action one contradicteth the other, for example, let one of my judgements be, that it is good for me to eat because I am hungry; and let the other be, that it is good for me to study, because I am shortly to give an account of my self; if the one judgement be stronger than the other, as if that of eating be stronger than that of studying, it importeth not that there be more reason (all circumstances considered) for studying: because, reasons do move to action according to the measure in which the resolution that is taken upon them, is strong or weak; and therefore, my action will follow the strongest

ſtrongeſt judgement, and I ſhall leave my book to go to my dinner.

Now, to apply this to the ſtate of a ſeparated ſoul; we are to remember how the ſpirituall judgements, which ſhe collected in the body, do remain in her after ſhe is diveſted of it: and likewiſe, we are to conſider, how all her proceeding in that ſtate, is built, not upon paſſion, or any bodily cauſes or diſpoſitions; but meerly upon the quality and force of thoſe ſpiritual judgements: and then, it evidently followeth, that if there were any ſuch action in the next life, the pure ſoul would apply it ſelf thereunto, according to the proportion of her judgements, and as they are graduated and qualified. It is true, there is no ſuch action remaining in the next life; yet nevertheleſſe there remaineth in the ſoul a diſpoſition and a promptitude to ſuch action; and if we will frame a right apprehenſion of a ſeparated ſoul, we muſt conceit her to be of ſuch a nature (for then all is nature with her, as hereafter we ſhall diſcourſe,) as if ſhe were a thing made for action in that proportion and efficacity, which the quartering of her by this variety of judgements doth afford; that is, that ſhe is ſo much the more fit for one action than for another, (were ſhe to proceed to action,) as the judgement of the goodneſſe of one of theſe actions is ſtronger in her, than the judgement of the others goodneſs, which is in effect, by how much the one is more cultivated than the other. And out of this we may conclude, that what motions do follow in a man, out of diſcourſe, the like will in a ſeparated ſoul, follow out of her ſpiritual judgements. So that as he is joyed, if he do poſſeſs his deſired good; and is diſtontented and diſpleaſed, if he miſſe of it, and ſeizeth greedily upon it when it is preſent to him, and then cleaveth faſt unto it, and whiles he wanteth it, no other good affecteth him, but he is ſtill longing after that Maſterwiſh of his heart: the like in every regard, but much more vehemently, befalleth unto a ſeparated ſoul. So that in fine ſhe will be happy, or miſerable, according as ſhe hath built up her ſelf, by her ſpiritual judgements and affections in this life. If knowledge and intellectual objects be the goods ſhe thirſteth after, what can be happier than ſhe, when ſhe poſſeſſeth the fulneſs

fulneſs of all that can be deſired in that kinde? But if in this world a man ſettleth his heart conſtantly upon any tranſitory end; as upon wealth, corporeal delights, honor, power, and the like, (which are too ſhort-breathed attendants to follow him ſo long a journey as into the next;) then, all the powers of his ſoul, even after ſhe hath left her body, will be ſtill longing after that dear Idol of her affections; and for the want of it, ſhe will not value the great knowledge ſhe ſhall then be imbued withall, nor care for any other good ſhe poſſeſſeth; like a man who being ſorrounded with a full ſea and ſwoln tide of all ſpecious objects that may pleaſe and delight him, hath by unluckly chance ſuffered his violent affections, and his impotent deſires to be intangled in ſome mean love, that either neglecteth him, or he is hindered from enjoying; and thereby, that little drop of gall, or rather that privation of a mean contentment (which truly in it ſelf, is nothing) infecteth and poyſoneth the whole draught of happineſs, that but for this, would ſwell him up to the height of his wiſhes.

5. The ſtate of a vicious ſoul in the next life.

But no compariſons of ſorrowe, griefs, or anguiſhes in this life (where our earthly dwelling doth ſo clog, and allay, and dull the ſenſe of our ſoul, which onely feeleth and reliſheth either delight or wo) can arrive to ſhadow out the miſery of a ſeparated ſoul ſo affected; whoſe ſtrains are ſo exceſſively vehement, and whoſe nature is a pure activity, and her ſelf, all ſenſe, all knowledge. It is true, I confeſſe, that in a man, ſuch motions do in part proceed from paſſion: and therefore, I will allow, that ſo much of them, as have their origin meerly and only from thence, ſhall die with the body, and ſhall not have made any impreſſion in the ſeparated ſoul: but beſides the ſtream of paſſion we may in ſuch motions obſerve alſo, the work of reaſon, for ſhe, both approveth and employeth her powers, to compaſſe and gain what the other preſenteth, and by legitimate diſcourſe, draweth conſequences out of that principle or judgement, which maketh the byas, it then leaneth unto: and theſe, are undeniable effects of a ſpiritual judgement ſettled in the ſoul. And therefore, as far as theſe motions proceed from ſpiritual judgments, ſo far, it is clear they muſt remain in the ſeparated ſoul.

Peradventure

Peradventure, what I have ſaid, may be lyable to a miſtake; as though I conceived that theſe ſpirituall judgements are made in the ſoul according to right reaſon, and to legitimate diſcourſe: whereas, I mean nothing leſſe; but eſteeming an overſtrong judgement in the ſeperated ſoul, to be proportionable unto a paſſion in the body; I conceit, that as paſſion ſetteth reaſon on work to finde out means, whereby ſhe may arrive unto her ends; ſo in like manner, may this judgement ſet reaſon on float, with thoſe acts which follow conſequently upon it (though inconſequent to the whole body of reaſon:) becauſe the diſorder there, is, in the exceſſe of this judgement over others, whoſe force (according to nature) ought to be greater than it. So that, if we would frame a conception of a diſordered ſoul, when it is out of the body; we may imagine it correſpondent to a body, whoſe one part were bigger than could ſtand in proportion with another, as, if the hand (to uſe the example we brought before) were greater than the arm could manage, or the foot were larger and heavier, than the leg and thigh could wield: unto which add, that every part were active and working of it ſelf: ſo as, though it could not be governed, yet would it continually have its own operation, which would be contrary to the operation of the arme, or of the legge, and conſequently, it would ever be tending to incompoſſible operations: and by that means, both one member would alwaies diſagree from the other, and neither of them attain any effect at all; not unlike to the fanſie of the Poets, who feigned a monſter, which they termed *Scylla*, whoſe inferiour parts, were a company of doge, ever ſnarling and quarrelling among themſelves; and yet were unſeverable from one another, as being compartes of the ſame ſubſtance.

But to declare this important doctrine more dogmatically; let us conſider that of neceſſity a diſordered ſoul hath theſe following judgements ſettled in her. Namely, that ſhe is not well; that ſhe cannot be well without her deſired good; that it is impoſſible for her to compaſſe that good; and laſtly, that this ſtate ſhe is in, is by all means poſſible to be avoyded; not by changing her judgement (for that is her

ſelf)

ſelf) but by procuring the ſatisfaction ſhe deſireth; and this with all the power, and total inclination of her activity and poſſibility. This then, being the temper of a diſordered ſeparated ſoul, it is eaſie to conceive, what a ſad condition ſuch an one remaineth then in; which is infinitely more, than any affliction that can happen to a man in this world: for ſince, even here, all our joyes and griefs, do proceed from our ſoul; we muſt needs allow, that when ſhe ſhall be from the burthen of her body (which doth exceedingly impeach, and limit her operations, and activity) all her actions will be then far greater and more efficacious.

6. The fundamental reaſon why as well happineſſe as miſery is ſo exceſſive in the next life.

But becauſe this point is of higheſt conſequence, we may not ſlightly paſſe it over; but we will endeavour, if we can, to diſcover the wonderfull efficacy and force of a ſeparated ſouls operations; that from thence we may the better collect, how great her happineſſe or miſery will be in the next life. Let us then conſider, how an act or judgement of the ſoule, may be more forcible, either by it ſelfe, or by the multiplication of ſuch helps, as do concurre with it. To begin with conſidering the Act in it ſelf, we know that the certaineſt way to meaſure the ſtrength of it, is to take a ſurvey of the force which ſheweth it ſelf in its effect: for the being relatives to one another, each of them diſcovereth the others nature; Now, this we will do after our ordinary manner, by comparing the ſpirituall effects iſſuing from a judgement in the ſoul, to materiall effects proceeding from the operations and motions of bodies. In theſe we may obſerve three things, by which we may eſtimate their efficacioufneſſe: ſome actions dure a longer time; others, take up a greater place, and others again, work the like effect in a greater place, and in a ſhorter time: which laſt ſort, of all others, do proceed from the moſt powerfull, and moſt forcible agents. If then in theſe conſiderations we compare a ſeparated ſoul to a body; what an infinity of ſtrength and efficacity, will the meaneſt of thoſe pure ſubſtances have, beyond the moſt powerfull and active body that can be imagined in Nature? For we have already ſhewed, how a ſeparated ſoule comprehendeth at once, all place, and all times: ſo that, her activity requireth no application

cation to place or time; but, ſhe is, of her ſelf, miſtreſſe of both, comprehending all quantity whatſoever, in an indiviſible apprehenſion; and ranking all the parts of motion, in their compleat order: and knowing at once, what is to happen in every one of them. On the other ſide; an incorporated ſoul, by reaſon of her being confined to the uſe of her ſenſes, can look upon but one ſingle definite place, or time, at once; and needeth a long chain of many diſcourſes to comprehend all the circumſtances of any one action: and yet after all, how ſhort ſhe is of comprehending all? So that comparing the one of theſe with the other, it is evident, that in reſpect of time and place; and in reſpect of any one ſingular action, the proportion of a ſeparated ſoul, to one in the body, is as all time, or all place, in reſpect of any one piece, or leaſt parcel of them; or as the entire abſolute comprehender of all time and all place, is to the diſcoverer of a ſmall meaſure of them. For whatſoever a ſoul willeth in that ſtate, ſhe willeth it for the whole extent of her duration; becauſe ſhe is then out of the ſtate or capacity of changing: and wiſheth for whatſoever ſhe wiſheth, as for her abſolute good; and therefore employeth the whole force of her judgement, upon every particular wiſh. Likewiſe the eminency which a ſeparated ſoul hath over place, is alſo then entirely employed upon every particular wiſh of hers; ſince in that ſtate there is no variety of place left unto her, to wiſh for ſuch good in one place, and to refuſe it in an other; as, whiles ſhe is in the body hapneth to every thing ſhe deſireth. Wherefore, whatſoever ſhe then wiſheth for, ſhe wiſheth for it according to her compariſon unto place: that is to ſay, that as ſuch a ſoul hath a power to work at the ſame time in all place by the abſolute comprehenſion, which ſhe hath of place in abſtract: ſo every wiſh of that ſoul if it were concerning a thing to be made in place, were able to make it in all places; through the exceſſive force and efficacy which ſhe employeth upon every particular wiſh.

The third effect by which among bodies we gather the vigor and energy of the cauſe that produceth it, (to wit, the doing of the like action, in a leſſer time and in a larger extent,) is but a combination of the two former: and therefore it requireth no further particular inſiſtance upon it, to ſhew, that likewiſe in this, the proportion of a ſeparated to an incorporated

ſoul, muſt needs be the ſelf ſame as in the others; ſeeing that a ſeparated ſouls activity, is upon all place in an indiviſible of time

Therefore to ſhut up this point; there remaineth onely for us to conſider, what addition may be made unto the efficacity of a judgement, by the concurrence of other extrinſicall helps. We ſee that when an underſtanding man will ſettle any judgement, or concluſion in his mind, he weigheth throughly all that followeth out of ſuch a judgement; and conſidereth likewiſe all the antecedents that lead him unto it: and if after due reflection, and examination, of whatſoever concerneth this concluſion which he is eſtabliſhing in his minde, he findeth nothing to croſſe it, but that every particular and circumſtance goeth ſmoothly along with it, and ſtrengtheneth it; he is then ſatisfied, and quiet in his thoughts, and yieldeth a full aſſent thereunto: which aſſent is the ſtronger, by how many the more concurrent teſtimonies he hath for it. And although he ſhould have a perfect demonſtration or ſight of the thing in it ſelf, yet every one of the other extrinſecall proofs, being as it were a new perſwaſion, hath in it a farther vigor to ſtrengthen and content his minde in the forehad demonſtration: for if every one of theſe be in it ſelf ſufficient to make the thing evident; it cannot happen that any one of them, ſhould hinder the others: but contrariwiſe, every one of them muſt needs concurre with all the reſt, to the effectual quieting of his underſtanding, in its aſſent, to that judgement. Now then, according to this rate, let us calculate, (if we can) what concurrence of proofs and witneſſes a ſeparated ſoul will have to ſettle and ſtrengthen her in every one of her judgements. We know, that all verities are chained, and connected one to another; and that there is no true concluſion ſo far remote from any other, but may by more, or leſſe conſequences and diſcourſes, be deduced evidently out of it: it followeth then, that in the abſtracted ſoul, where all ſuch conſequences are ready drawn, and ſeen in themſelves without extenſion of time or employing of pains to collect them; every particular verity, beareth teſtimony to any other, ſo that every one of them is believed, and worketh in the ſenſe and vertue of all. Out of which it is manifeſt, that every judgement in ſuch a ſeparated ſoul, hath an infinite ſtrength and efficacity over any, made by an embodyed one.

To

To ſum all up in a few words: we finde three roots of infinity in every action of a ſeparated ſoul, in reſpect of one in the body: firſt, the freedom of her eſſence or ſubſtance in it ſelf: next, that quality of hers, by which ſhe comprehendeth place and time; that is, all permanent and ſucceſſive quantity: and laſtly, the concurrence of infinite knowledges to every action of hers. Having then this meaſure in our hands, let us apply it to a well-ordered, and to a diſordered ſoul, paſſing out of this world: let us conſider the one of them, ſet upon thoſe goods, which ſhe ſhall there have preſent, and ſhall fully enjoy: the other, languiſhing after, and pining away for thoſe, which are impoſſible for her ever to obtain. What joy, what content, what exultation of minde, in any living man, can be conceived ſo great, as to be compared with the happineſs of one of theſe ſouls? And what grief, what diſcontent, what miſery can be like the others?

7. The reaſon why mans ſoul requireth to be in a body, and to live for ſome ſpace of time joyned with it.

Theſe are the different effects, which the divers manners of living in this world, do cauſe in ſouls after they are delivered from their bodies: out of which, and out of the diſcourſe that hath diſcovered theſe effects unto us, we ſee a clear reſolution of that ſo main and agitated queſtion among the Philoſophers, why a rational ſoul is impriſoned in a groſs body of fleſh and blood? In truth, the queſtion is an illegitimate one; as ſuppoſing a falſe ground: for the ſouls being in the body, is not an impriſonment of a thing that was exiſtent, before the ſoul and body met together; but her being there, is the natural courſe of beginning that, which can no other way come into the lifts of nature: for ſhould a ſoul, by the courſe of nature, obtain her firſt being without a body, either ſhe would in the firſt inſtant of her being, be perfect in knowledge, or ſhe would not: if ſhe were, then ſhould ſhe be a perfect & compleat immaterial ſubſtance, not a ſoul; whoſe nature is to be a compartner to the body; and to acquire her perfection by the mediation and ſervice of corporeal ſenſes: but if ſhe were not perfect in ſcience, but were onely a capacity thereunto, and like unto white paper, in which nothing were yet written; then unleſs ſhe were put into a body, ſhe could never arrive to know any thing, becauſe motion and alteration are effects peculiar to bodies: therefore, it muſt be agreed, that ſhe is naturally deſigned to be in a body. but her being in a body, is her being one thing with the body, ſhe is ſaid to

be in: and ſo ſhe is one part of a whole, which from its weaker part is determined to be a body.

Again, ſeeing that the matter of any thing, is to be prepared, before the end is prepared, for which that matter is to ſerve; according to that Axiome, *Quod eſt primum in intentione, eſt ultimum in executione:* we may not deny, but that the body is in being, ſome time before the ſoul; or at the leaſt, that it exiſteth as ſoon as ſhe doth: and therefore, it appeareth wholly unreaſonable, to ſay, that the ſoul was firſt made out of the body, and was afterwards thruſt into it; ſeeing that the body was prepared for the ſoul before, or at the leaſt, as ſoon as ſhe had any beginning: and ſo we may conclude, that of neceſſity the ſoul muſt be begun, layed, hatched, and perfected in the body.

And although it be true, that ſuch ſouls as are ſeparated from their bodies, in the firſt inſtant of their being there, are notwithſtanding imbued with the knowledge of all things; yet is not their longer abode there in vain: not onely, becauſe thereby the ſpecies is multiplied; (for nature is not content with barely doing that, without addition of ſome good to the ſoul it ſelf) but as for the wonderfull, and I may ſay infinite advantages that may thereby accrew to the ſoul, if ſhe make right uſe of it: for, as any act of the abſtracted ſoul is infinite, in compariſon of the acts which men exerciſe in this life, (according to what we have already ſhewed) ſo by conſequence, muſt any increaſe of it, be likewiſe infinite: and therefore we may conclude, that a long life well ſpent, is the greateſt and moſt excellent gift, which nature can beſtow upon a man.

8. That the miſery of the ſoul in the next world, proceedeth out of inequality, and not of falſity of her judgements.

The unwary Reader may perhaps have difficulty, at our often repeating of the infelicity of a miſerable ſoul: ſince we ſay, that it proceedeth out of the judgements, ſhe had formerly made in this life; which without all doubt were falſe ones: and nevertheleſs, it is evident, that no falſe judgements, can remain in a ſoul, after ſhe is ſeparated from her body; as we have above determined. How then can a ſouls judgements, be the cauſe of her miſery? But the more heedfull Reader, will have noted, that the miſery which we put in a ſoul, proceedeth out of the inequality, not out of the falſity of her judgements: for if a man be inclined to a leſſer good, more than to a greater, he will in action betake himſelf to the leſſer good,

good, and desert the greater, (wherein, neither judgement is false, nor either inclination is naught) meerly out of the improportion of the two inclinations or judgments to their objects: for that a soul may be duly ordered, and in a state of being well, she must have a lesser inclination to a lesser good, and a greater inclination to a greater good: and in pure spirits, these inclinations are nothing else, but the strength of their judgments: which judgments in souls, whiles they are in their bodies, are made by the repetition of more acts from stronger causes, or in more favourable circumstances. And so it appeareth, how without any falsity in any judgment, a soul may become miserable, by her conversation in this world; where all her inclinations generally are good, unless the disproportion of them, do make them bad.

THE TWELFTH CHAPTER.

Of the perseverance of a soul, in the state she findeth her self in, at her first separation from her body.

THus we have brought mans soul, out of the body she lived in here, and by which she conversed, and had commerce with the other parts of this world: and we have assigned her, her first array and stole, with which she may be seen in the next world: so that now there remaineth only for us to consider, what shall betide her afterwards; and whether any change may happen to her, and be made in her, after the first instant of her being a pure spirit, separated from all consortship with material substances. To determine this point the more clearly, let us call to mind, an axiom that *Aristotle* giveth us in his logick; which teacheth us, *That as it is true, if the effect be, there is a cause; so likewise it is most true, that if the cause be in act, or causing, the effect must also be.* Which *Axiom* may be understood two waies: the one, that if the cause hath its effect, then the effect also is: and this is no great mystery; or for it, are any thanks due to the teacher; it being but a repetition, and saying over again of the same thing. The other way is, that if the cause be perfect in the nature of being a cause, than the effect is: which is as much as to say, that if nothing be wanting to the cause, abstracting precisely from the effect; then neither is

1. The explication, and proof of that maxim, that, if the cause be in act, the effect must also be.

the effect wanting. And this is the meaning of *Aristotles* Axiom: of the truth and evidence whereof in this sense, if any man should make the least doubt, it were easie to evince it: as thus, if nothing be wanting but the effect, and yet the effect doth not immediately follow, it must needs be that it cannot follow at all; for if it can, and doth not, then something more must be done to make it follow: which is against the supposition, that nothing was wanting but the effect; for that which it is to be done, was wanting. To say, it will follow without any change, is senseless: for if it follow without change, it followeth out of this, which is already put: but if it do follow out of this which is precisely put, then it followeth, against the supposition, which was, that it did not follow, although this were put.

The effects of all such agents as worke instantaneously, are compleat in the first instant that the agents are put.

2. This then being evident, let us apply it to our purpose; and let us put three or more things, namely A. B. C. and D. whereof none can work otherwise, than in an instant or indivisibly: and I say, that whatsoever these four things are able to do, without respect to any other thing besides them, is compleatly done in the first instant of their being put: and if they remain for all eternity, without communication or respect to any other thing, there shall never be any innovation in any of them, or any farther working among them: but they will alwaies remain immutable, in the same state they were in, at the very first instant of their being put: for whatsoever A. can do, in the first instant, is in that first instant actually done; because he worketh indivisibly: and what can be done precisely by A. and by his action joyned to B. doth precisely follow out of A. and his action, and out of B. and his action, if B. have any action independent of A. and because all these are in the same instant, whatsoever followeth precisely out of these, and out of any thing else that is in the same instant, and that worketh indivisibly as they do; is necessarily done in that very instant; but all the actions of C. and D. and of whatsoever by reflection from them may be done by A. and B. being all of them indivisible and following precisely out of some of the forenamed actions; they do follow out of things being in this instant: and because they are indivisible, they may be in this instant: and therefore all is done in this instant. Now supposing all to be done that can be done by them in this instant; & that nothing can follow from them, unless it follow precisely out of what is in this instant; and that is is all indivisible:

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it followeth clearly, that whatsoever (concerning them) is not in this instant, can never be.

These two conclusions being thus demonstrated; let us in the next place determine, how all actions of pure spirits, which have no respect to bodies, must of necessity be indivisible; that is, must include no continuate succession: by which, I mean such a succession, as may be divided into parts without end: for if we look well into it, we shall finde, that a continuate succession cannot be a thing, which hath in it self a *Being*: and the reason is, because the essence of such a succession, consisteth in having some of its parts already passed, and others of them yet to come: but on the other side, it is evident, that no such thing can be, whose essential ingredients are not it self: and therefore it followeth evidently, that such a thing as we call succession, can have no being in it self: seeing that one essential part of it, never is with the other: therefore, such a succession, must have its being in some permanent thing, which must be divisible; for that is essentially required in succession: but permanent divisibility is that, which we call bigness or quantity; from which pure spirits are free: and therefore, it is most evident, that all their actions in respect of themselves, are absolutely indivisible.

3. All pure spirits do work instantaneously.

Now, to make use of this doctrine to our intent: we say, that since our soul, when it is separated from our body, is a pure spirit or understanding; and that all her actions are indivisible; and that all actions of other spirits upon her, must likewise be such; and by consequence, that there can be no continuate succession of action among them: we must of necessity conclude, that according to the private nature of the soul, and according to the common notion of spiritual things; there can be no change made in her, after the first instant of her parting from her body: but what happiness or misery betideth her in that instant, continueth with her for all eternity. Yet it is not my minde to say, that by the course of the universal resolutions, from which she is not wholly exempt, and from supernatural administration of corporal things, there may not result some change in her. But the consideration of that matter, I remit to those treatises, unto which it belongeth; as not depending, nor ensuing from the particular nature of the soul: and therefore, not falling under our discussion in this place.

4. That a soul separated from her body cannot suffer any change after the first instant of her separation.

This same Conclusion may be proved by another argument,

beſides this which we have now uſed; and it is this. Whatſoever worketh purely by underſtauding and minde, cannot be changed in its operations, unleſs its underſtanding or minde, be altered: but this cannot happen, unleſs either it learn ſomewhat, it knew not before; or forgeting a foreknown truth, it begin afterwards to think a falſity. This ſecond part, is impoſible, as we have already ſhewed, when we proved that falſhood could have no admittance into a ſeparated ſoul: and the former is as impoſſible; it being likewiſe proved, that at her firſt inſtant of her ſeparaton, ſhe knoweth all things: wherefore, we may hence confidently conclude, that no change of minde, (that is, no change at all) can happen to an abſtracted ſoul.

5. That temporal ſins are juſtly puniſhed with eternal pains.

And thus, by diſcourſe, we may arrive, to qu't our ſelves eaſily of that famous objection, ſo much peſtering Chriſtan Religion; how God, can in juſtice impoſe eternal pains upon a ſoul, for one ſin, acted in a ſhort ſpace of time. For we ſee, it followeth by the neceſſary courſe of nature, that if a man die in a diſorderly affection to any thing, as to his chief good, he eternally remaineth by the neceſſity of his own nature, in the ſame affection: and there is no imparity, that to eternal ſin, there ſhould be impoſed eternal puniſhment.

THE

THE CONCLUSION.

AND now I hope, I may confidently ſay, I have been as good as my word: and I doubt not, but my Reader will finde it ſo, if he ſpend but half as much time in peruſing theſe two Treatiſes, as the compoſing them hath coſt me. They are too nice (and indeed, unreaſonable) who expect to attain without pains, unto that, which hath coſt others years of toil. Let us carefully purſue the hidden bounties he hath treaſured up for us. Let them remember the words of holy *Job*, that *wiſdome is not found in the hand of thoſe, that live at their eaſe.* Let them caſt their eyes on every ſide round about them, and then tell me, if they meet with any employment, that may be compared to the attaining unto theſe, and ſuch like Principles; whereby a man is enabled to govern himſelf underſtandingly and knowingly, towards the happineſs, both of the next life and of this; and to comprehend the wiſe mans theme; *What is good for a man in the daies of his vanity, whiles he playeth the ſtranger under the ſun.* Let us fear Gods judgments. Let us thank him for the knowledge he hath given us: and admire the excellency of Chriſtian Religion; which ſo plain'y teacheth us that, unto which it is ſo extreme hard to arrive by natural means. Let us bleſs him, that we are born unto it. And let us ſing to him; *That it is he, who preacheth his doctrine to Jacob, and giveth his laws to Iſrael. He hath not done the like to all nations; nor hath he manifeſted his ſecret truths unto them.*

BUt before I cut off this thread, which hath coſt me ſo much pains to ſpin out to this length; I muſt crave my Readers leave, to make ſome uſe of it, for my own behoof. Hitherto my diſcourſe hath been directed to him: now I ſhall intreat his patience, that I may reflect it in a word or two upon my ſelf. And as I am ſure I have profited my ſelf not a little, by talking all this while to him, that obliging me to poliſh my conceptions with more care, and to range them into better order, than whiles they were but rude meditations within my own breſt; ſo I hope, that a little con-

converſation with my ſelf upon this important ſubject, (which is to be ſtudied for uſe, and practice; not for ſpeculative ſcience) may prove advantagious unto him; if his warmed thoughts have turned his ſoul to ſuch a key, as I am ſure theſe conſiderations have wound up mine unto.

To thee then my ſoul, I now addreſs my ſpeech. For ſince by long debate, and toilſom rowing againſt the impetuous tides of ignorance, and falſe apprehenſions, which overthrow thy banks, and hurry thee headlong down the ſtream, whiles thou art impriſoned in thy clayie manſion; we have with much ado arrived to aim at ſome little attome of thy vaſt greatneſs; and with the hard and tough blows of ſtrict and wary reaſoning, we have ſtrucken out ſome few ſparks of that glorious light, which invironeth and ſwelleth thee, or rather, which is thee: it is high time, I ſhould retire my ſelf out of the turbulent and ſlippery field of eager ſtrife and litigious diſputation, to make my accounts with thee; where no outward noiſe may diſtract us, nor any way intermeddle between us, excepting onely that eternal verity, which by thee ſhineth upon my faint and gloomy eyes: and in which I ſee, whatſoever doth or can content thee in me. I have diſcovered, that thou (my ſoul) wilt ſurvive me: and ſo ſurvive me, as thou wilt alſo ſurvive the mortality, and changes which belong to me; and which are but accidentary to thee, meerly becauſe thou art in me. Then ſhall the viciſſitude of time, and the inequality of diſpoſitions in thee, be turned into the conſtancy of immortality; and into the evenneſs of one being, never to end, and never to receive a change, or ſucceſſion to better or worſe.

When my eye of contemplation hath been fixed upon this bright ſun, as long as it is able to endure the radient beams of it; whoſe redundant light veileth the looker on, with a dark miſt: let me turn it for a little ſpace, upon the ſtreight paſſage, and narrow gullet, through which thou ſtriveſt (my ſoul) with faint and weary ſteps, during thy hazardous voyage upon the earth, to make thy ſelf away: and let me examine, what compariſon there is, between thy two conditions; the preſent one, wherein thou now findeſt thy ſelf immerſed in fleſh and blood; and the future ſtate that will betide thee, when thou ſhalt be melted out of this groſs oar, and refined from this mean alloy. Let my terme of life, be of a thouſand long years; longer than ever happened to our aged fore-fathers, who ſtored the earth with their numerous

progeny, by outliving their skill to number the diffused multitudes that swarmed from their loyns: let me, during this long space, be sole Emperor and absolute Lord, of all the huge Glode of Land and water, encompassed with *Adams* off-spring: let all my subjects lie prostrate at my feet, with obedience and aw, distilling activest thoughts, in studying day and night to invent new pleasures and delight for me: let nature conspire with them, to give me a constant and vigorous health; a perpetual spring of youth, that may to the full relish whatsoever good all they can fansie: let gravest Prelates, and greatest Princes, serve instead of flatterers to highten my joyes; and yet those joyes, be raised above their power of flattery: let the wisedom of this vast family (whose sentiments, are maxims and oracles, to govern the worlds beliefs and actions) esteem, reverence, and adorn me in the secretest, and the most recluse withdrawings of their hearts: let all the wealth, which to this very day, hath ever been torn out of the bowels of the earth; and all the treasures, which the sea hideth from the view of greedy men, swell round about me; whilst all the world besides, lyeth gaping to receive the crums, that fall neglected by me, from my full loaden table: let my imagination be as vast, as the unfathomed University; and let my felicity be as accomplished, as my imagination can reach unto; so that following in pleasure, I be not able to thinke how to increase it, or what to wish for more, than that which I possesse and enjoy.

Thus when my thoughts are at a stand, and can raise my present happiness no higher; let me call to minde, how this long lease of pleasant daies, will in time come to an end: this bottom of a thousand joyful years, will at length be unwound, and nothing remain of it: and then (my soul) thy infinitely longer-lived Immortality will succeed; thy never ending date will begin a new account, impossible to be summed up, and beyond all proportion infinitely exceeding the happiness we have rudely aimed to expresse: so that no comparison can be admitted between them. For, suppose first that such it were, as the least and shortest of those manifold joyes, which swell it to that height we have fansied, were equal to all the contentment thou should'st enjoy in a whole million of years; yet millions of years may be so often multiplied, as at length, the slender and limited contentments supposed them, may equalise, & outgo the whole heap of overflowing

raiſed ſo high, in the large extent of theſe thouſand happy years. Which when they are caſt into a total ſum; and that I compare it, with the unmeaſurable eternity, which onely meaſureth thee; then I ſee, that all this huge product of Algebraical multiplication, appeareth as nothing, in reſpect of thy remaining, and never-ending ſurvivance; and is leſſe, than the leaſt point in regard of the immenſe Univerſe. But then, if it be true (as it is moſt true) that thy leaſt ſpark and moment of real happineſs, in that bleſſed eternity thou hopeſt for, is infinitely greater, and nobler, than the whole maſſe of fanſied joyes, of my thouſand years life here on earth; how infinitely will the value of thy duration, exceed all proportion, in regard of the felicity, I had imagined my ſelf? And ſeeing there is no proportion between them, let me ſadly reflect upon my own preſent condition: let me examine what it is, I ſo buſily, and anxiouſly, employ my thoughts & precious time upon: let me conſider my own courſes, and whither they lead me: let me take a ſurvay of the lives, and actions, of the greateſt part of the world, which make ſo loud a noyſe about my ears: and then may I juſtly ſigh out from the bottom of my anguiſhed heart; to what purpoſe have I hitherto lived? To what purpoſe are all theſe millions of toilſome antes, that live and labour about me? To what purpoſe were *Cæſars* and *Alexanders*? To what purpoſe *Ariſtotles* and *Archimedes*? How miſerably fooliſh are thoſe conquering Tyrants, that divide the world with their lawleſs ſwords? What ſenſeleſs idiots thoſe acute Philoſophers, who tear mens wits in pieces, by their different waies, and ſubtile Logick; ſtriving to ſhew men beatitudes in this world, and ſeeking for that, which if they had found, were but a nothing of a nothing in reſpect of true beatitude? He onely is wiſe, who neglecting all that fleſh and blood deſireth, endeavoreth to purchaſe at any rate this felicity, which thy ſurvivance promiſeth: the leaſt degree of which ſo far ſurmounteth all the heaps, which the Gyants of the earth are able to raiſe, by throwing hills upon hills, and ſtriving in vain to ſcale and reach thoſe eternities, which reſide about the skye. Alas how fondly doth mankind ſuffer it ſelf ſo be deluded? How true it is, that the only thing neceſſary, proveth the only that is neglected? Look up my ſoul, and fix thine eye upon that truth, which eternal light maketh ſo clear unto thee, ſhining upon thy face with ſo great evidence, as defieth the noontide Sun, in its greateſt brightneſſe.

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And this it is, that every action of thine, be it never so slight, is mainly mischievous; or be it never so bedeck'd with those specious considerations, which the wise men of the world judge important, is foolish, absurd, and unworthy of a man; and unworthy of one that understandeth, and acknowledgeth thy dignity; if in it there be any speck; or if through it, there appear any spark of those mean and flat motives, which with a false bias, draw any way aside, from attaining that happiness, we expect in thee. That happiness, ought to be the end, and mark we level at: that, the rule and model of all our actions: that, the measure of every circumstance, of every atom, of whatsoever we bestow so precious a thing upon, as the employment of thee is.

But we must not so slightly passe over the intenseness and vehemence of that felicity which thou (my soul) shalt enjoy, when thou art severed from thy benumming compartner. I see evidently, that thou dost not survive, a simple and dull essence; but art replenished with a vast and incomprehensible extent of riches & delight within thy self. I see that golden chain, which here by long discourse, filleth huge volums of Books, and diveth into the hidden natures of several bodies: in thee resumed into one circle or linke, which containeth in it self the large scope of whatsoever screwing discourse can reach unto. I see it comprehend, and master the whole world of bodies. I see every particular nature, as it were imbossed out to the life, in thy celestial garment. I see every solitary substance ranked in its due place and order, not crushed or thronged by the multitude of its fellows; but each of them in its full extent, in the full propriety of every part and effect of it; and distinguished into more divisions, than ever nature severed it into. In thee I see an infinite multitude enjoy place enough. I see, that neither height, nor profundity, nor longitude enough, nor latitude, are able to exempt themselves from diffused powers: they fadom all, they comprehend all; they master all; they inrich thee with the flock of all; and thou thy self art all, and somwhat more than all; and yet, now but one of all. I see, that every one of this all, in thee increaseth the strength, by which thou knowest any other of the same all: and all, encreaseth the knowledge of all, by a multiplycation beyond the skill of Arithmetick; being (in its kinde) absolutely infinite; by having a nature, that is incapable of being either infinite or finite. I see again, that those things which have

not knowledge, are ſituated in the loweſt, and meaneſt rank of creatures; and are in no wiſe comparable to thoſe which know. I ſee, there is no pleaſure at all, no happineſs, no felicity, but by knowledge, and in knowledge. Experience teacheth me, how the purer, and nobler race of mankinde, adoreth in their hearts, this idol of knowledge, and ſcorneth what ever elſe they ſeem to court, and to be fond of. And I ſee, that this exceſs of ſea of knowledge which is in thee, groweth not by the ſucceſſion of one thought after another; but it is like a full-ſwoln ocean, never ebbing on any coaſt, but equally puſhing at all its bounds, and tumbling out its flowing waves on every ſide, and into every creek; ſo that every where it maketh high tide. Or like a pure Sun, which from all parts of it ſhooteth its radiant beams with a like extremity of violence. And I ſee likewiſe, that this admirable knowledge, is not begotten and conſerved in thee, by the accidentary help of defective cauſes; but is rooted in thy ſelf; is ſteeped in thy own eſſence, like an unextinguiſhable ſourſe of a perpetually-ſtreaming fire; or like the living head of an ever-running ſpring; beholding to none, out of thy ſelf, ſaving onely to thy Almighty Creator; and begging of none; but being in thy ſelf all that of which thou ſhouldeſt beg.

This then (my ſoul) being thy lot; and ſuch a hieght of pleaſure being reſerved for thee; and ſuch an extremity of felicity, with in a ſhort ſpace attending thee; can any degenerate thought, ever gain ſtrength enough, to ſhake the evidence which theſe conſiderations implant and rivet in thee? Can any dull oblivion deface this ſo lively and beautiful image? Or can any length of time, draw in thy memory a veil between it, and thy preſent attention? Can any perverſity, ſo diſtort thy ſtraight eyes, that thou ſhouldeſt not look alwaies fixed upon this mark; and level thy aim directly at this white? How is it poſſible, that thou canſt brook to live, and not expire preſently, thereby to ingulf thy ſelf, and be throughly imbibed with ſuch an overflowing bliſſe? Why doſt thou not break the walls and the chains of thy fleſh and blood, and leap into this glorious liberty? Here Stoicks, you are to uſe your ſwords. Upon theſe conſiderations, you may juſtifie the letting out the blood, which by your diſcourſes, you ſeem ſo prodigal of. To die upon theſe terms, is not to part with that, which you fondly call happy life; feeding your ſelves, and flattering your hearts

hearts with empty words: but rather it is, to plung your ſelves into a felicity, you were never able to imagaine, or to frame to your miſguided thoughts any ſcantling of it.

But nature pulleth me by the ears, and warneth me from being ſo wrongful to her, as to conceive, that ſo wiſe a governeſs ſhould to no advantage, condemn mankinde ſo long a baniſhment, as the ordinary extent of his dull life, & weariſome pilgrimage here under the Sun reacheth unto. Can we imagine, ſhe would allow him ſo much laiſie time, to effect nothing in? or can we ſuſpect that ſhe intended him no farther advantage, than what an abortive child arriveth unto in his mothers wombe? For whatſoever the nets and toils of diſcouſe can circle in; all that he, who but once knoweth that himſelf is, can attain unto as fully, as he that is enriched with the ſcience of all things in the world. For the connexion of things, is ſo linked together, that proceeding from any one, you reach the knowledge of many; and from many, you cannot fail of attaining of all: ſo that a ſeparated ſoul, which doth but know her ſelf, cannot chuſe but know her body too; and from her body, ſhe cannot miſſe in proceeding from the cauſes of them both, as far as immediate cauſes do proceed from others over them: and as little can ſhe be ignorant, of all the effects of thoſe cauſes ſhe reacheth unto. And thus, all that huge maſſe of knowledge, and happineſs which we have conſidered in our laſt reflection, amounteth to no more, than the filliеſt ſoul buried in warm blood, can and will infallibly attain unto, when its time cometh. We may then aſſure our ſelves, that juſt nature hath provided and deſigned a greater meaſure of ſuch felicity for longer livers: and ſo much greater, as may well be worth the pains and hazards of ſo miſerable and tedious a paſſage, as here (my ſoul) thou ſtruggleſt through. For certainly, if the dull perſecution, which by natures inſtitution, hammereth out a ſpiritual ſoul from groſſe fleſh and bloud, can atcheive ſo wondrous an effect, by ſuch blunt inſtruments, as are uſed in the contriving of a man: how can it be imagined, but that fifty or a hundred years beating upon far more ſubtile elements, refined in ſo long a time, as a child is becoming a man, and arriving to his perfect diſcourſe, muſt neceſſarily forge out in ſuch a ſoul, a ſtrange and admirable excellency, about the unlicked form of an abortive embrion? Surely, thoſe innumerable ſtroke (every one of which maketh a ſtrong impreſſion in the ſoul,

upon whom they beat) cannot chooſe but work a mighty difference in the ſubject that receiveth them, changing it ſtrangely from the condition it was in, before they begun to new mould it. What if I ſhould ſay, the odds between two ſuch ſouls, may peradventure be not unlike the difference between the wits and judgements of the ſubtileſt Philoſopher that ever was, and of the dulleſt child or idiot living? But this compariſon falleth too ſhort by far: even ſo much, that there is no reſemblance or proportion between the things compared: for as the exceſſe of great numbers over one another, drowneth the exceſſe of ſmall ones, and maketh it not conſiderable, in reſpect of theirs, although they ſhould be in the ſame proportion; ſo the advantages of a ſoul, forged to its higheſt perfection in a mans body, by its long abode there, and by its making right uſe of that precious time allowed it; muſt needs (in poſitive value, though not in Geometrical proportion) infinitly exceed, when it ſhall be delivered out of priſon, the advantages, which the newly hatched ſoul of an abortive infant ſhall acquire, at the breaking of its chains. In this caſe, I believe no man would be of *Cæſars* minde; when he wiſhed to be rather the firſt man in a contemptible poor Village, he paſſed through among the deſert mountains, than the ſecond man in *Rome*. Let us ſuppoſe, the wealth of the richeſt man in that barren habitation, to be one hundred Crowns; and that the next to him in ſubſtance, had but half ſo much as he: in like manner, in that opulent City, the head of the world, where millions were as familiar as pence in other places, let the exceſs of the richeſt mans wealth, be but (as in the former) double over his, that cometh next unto him; and there you ſhall find, that if the pooreſt of the two, be worth fifty millions, the other hath fifty millions more than he: whereas the formers petty treaſure, exceedeth his neighbours but by fifty crowns. What proportion is there, in the common eſtimation of affairs, between that trivial ſumme, and fifty millions? Much leſs is there, between the excellency of a ſeparated ſoul, firſt perfected in its body, and an other that is ſet looſe into compleat liberty, before its body arrived in a natural courſe, to be delivered into this world, and by its eye to enjoy the light of it. The change of every ſoul at its ſeparation from the body, to a degree of perfection, above what is enjoyed in the body, is in a manner infinite: and by a like infinite proportion, every degree of perfection it had in the body, is alſo then multiplied:

ed: what a vaſt product then of infinity, muſt neceſſarily be raiſed, by this multiplying inſtant of the ſouls attaining liberty, in a well-moulded ſoul; infinitely beyond that perfection, which the ſoul of an infant dying before it be born, arriveth unto? And yet we have determined that to be in a manner infinite. Here our skill of Arithmetick and proportions faileth us. Here we find infinite exceſs, over what we alſo know to be infinite. How this can be, the feeble eyes of our limited underſtanding, are too dull to penetrate into: but that it is ſo, we are ſure: the rigor of diſcourſe convinceth and neceſſarily concludeth it. That aſſureth us, that ſince every impreſſion upon the ſoul, while it is in its body, maketh a change in it; were there no others made, but meerly the iterating of thoſe acts which brought it from ignorance to knowledge; that ſoul, upon which a hundred of thoſe acts had wrought, muſt have a hundred degrees of advantage over an other, upon which onely one had beaten; though by that one, it had acquired perfect knowledge of that thing: and then in the ſeparation, theſe hundred degrees, being each of them infinitly multiplied, how infinitly muſt ſuch a ſoul exceed in that particular, (though we know not how) the knowledge of the other ſoul; which though it be perfect in its kind, yet had but one act to forge it out? when we arrive to underſtand the difference of knowledge, between the ſuperiour and inferiour ranks of intelligences; among whom, the loweſt knoweth as much as the higheſt, and yet the knowledge of the higheſt, is infinitly more perfect and admirable, than the knowledge of his inferiors: then, and not before, we ſhall throughly comprehend this myſtery. In the mean time, it is enough for us, that we are ſure, that thus it fareth with ſouls: and that by how much the excellency and perfection of an all-knowing and all-comprehending ſoul, delivered out of the body of a wretched embrion, is above the vileneſs of that heavy lump of fleſh, it lately quitted in his mothers womb; even by ſo much, and according to the ſame proportion, muſt the excellency of a compleat ſoul (compleated in its body) be in a pitch above the adorable majeſty, wiſdom, and auguſtneſs, of the greateſt and moſt admired oracle in the world, living embodied in fleſh and blood. Which as it is in a height, and eminency over ſuch an excellent and admirable man, infinitly beyond the exceſs of ſuch a man, over that ſilly lump of fleſh, which compoſeth the moſt contemptible idiot or embryon; ſo likewiſe, is the exceſs

ceſs of it, over the ſoul of an abortive embrion, (though by the ſeparation, grown never ſo knowing, and never ſo perfect) infinitly greater, than the dignity and wiſdom of ſuch a man, is above the feebleneſs and miſery of a new animated child. Therefore have patience my ſoul: repine not at thy longer ſtay here in this veil of miſery, where thou art baniſhed from thoſe unſpeakable joyes thou ſeeſt at hand before thee. Thou ſhalt have an overflowing reward for thy enduring and patienting in this thy darkſome priſon. Deprive not thy ſelf through miſchievous haſte, of the great hopes and admirable felicity that attend thee, canſt thou but with due temper ſtay for it. Be content to let thy ſtock lie out a while at intereſt; thy profits will come in vaſt proportions; and every year, every day, every hour, will pay thee intereſt upon intereſt: and the longer it runneth on, the more it multiplieth: and in the account thou ſhalt finde, if thou proceedeſt as thou ſhouldeſt, that one moment oftentimes bringeth in a greater increaſe unto thy ſtock of treaſure, than the many years thou didſt live and trade before: and the longer thou liveſt, the thicker will theſe moments arrive unto thee. In like manner as in Arithmetical numeration, every addition of the leaſt figure, multiplieth the whole ſum it findeth. Here thou wilt prove how true that rich man ſaid, who of his gains pronounced, that he had gotten little with great labour, and great ſums with little: ſo if thou beſtoweſt well thy time, thy latter ſums will bring thee in huge accounts of gain, upon ſmall expence of pains or imployments; whereas thy firſt beginnings are toilſome and full of pain, and bring in but ſlender profit.

By this time, my ſoul, I am ſure thou art ſatisfied, that the exceſs of knowledge & of pleaſure, wch thou ſhalt enjoy, is vaſtly beyond any thou art capable of here. But how may we eſteem the juſt proportion they have to one another? Or rather is not the pleaſure of a ſeparated ſoul, ſo infinitly beyond all that can be reliſhed by one embodied here in clay, that there is no proportion between them? At the leaſt, though we are not able to meaſure the one, let us do our beſt to aim and gueſſe at the improportion between them; and rejoyce that we finde that it is beyond our reach to conceive or imagine any thing nigh the truth and the huge exceſs of thy good (my ſoul) over the moſt I am capable of in this world. It is agreed, that the vehemence and intenſeneſs of any pleaſure, is proportionable to the activity, power, and energy of the ſubject, which

it

is affected with ſuch pleaſure; and to the gravitation, bent, and greatneſs, that ſuch a ſubject hath to the object that delighteth it. Now to rove at the force and activity, wherewith a ſeparated ſoul weigheth and ſtriveth to joyn it ſelf, to what its nature carrieth it unto; let us begin with conſidering the proportions of celerity and forcibleneſs, wherewith heavy bodies move downwards. I ſee a pound weight in one ſeale of the balance, weigheth up the other empty one with great celerity. But if into that you imagine a million of pounds to be put, you may well conceive, that this great exceſs, would carry up the ſingle pound weight with ſo much violence and ſpeed, as would hardly afford your eye liberty to obſerve the velocity of the motion. Let me multiply this million of pounds by the whole globe of the earth; by the vaſt extent of the great orb, made by the ſuns, or earths motion about the centre of the world; by the incomprehenſibility of that immenſe ſtore-houſe of matter and of bodies, which is deſigned in lump by the name of the Univerſe; of which we know no more, but that it is beyond all hope of being known, during this mortal life. Thus when I have heaped together a bulk of weight, equal to this unwieldy machine; let me multiply the ſtrength of its velocity, and preſſure over the leaſt atome imaginable in nature, as far beyond the limits of gravity, as the ingenious skill, wherewith *Archimedes* numbred the leaſt grains of ſand that would fill the world, can carry it: and when I have thus wearied my ſelf, and exhauſted the power of Arithmetick, and of Algebra, I finde there is ſtill a proportion between the atom and this unutterable weight: I ſee it is all quantitative; it is all finite; and all this exceſs vaniſheth to nothing, and becometh inviſible (like twinkling ſtars, at the riſing of the much brighter ſun) as ſoon as the loweſt and the meaneſt ſubſtance ſhineth out of that orb, where they reſide that ſcorn divisibility, and are out of the reach of quantity and matter. How vehement then muſt the activity and energy be, wherewith ſo puiſſant a ſubſtance ſhooteth it ſelf to its deſired object? and when it enjoyeth it, how violent muſt the extaſie and tranſport be, wherewith it is delighted? How is it poſſible then for my narrow heart, to frame an apprehenſion of the infinite exceſs of thy pleaſure (my ſoul) over all the pleaſure this limited world can afford, which is all meaſured by ſuch petty proportions? How ſhould I ſtamp a figure of thy immenſe greatneſs, into my material imagination? Here I

loſe my power of ſpeaking, becauſe I have too much to ſpeak of: I muſt become ſilent and dumb, becauſe all the words and language I can uſe, expreſs not the thouſandth, nor the millionth part, of what I evidently ſee to be true. All I can ſay is, that whatſoever I think or imagine, it is not that: and that it is not like any of thoſe things; unto ſome of which unleſs it be like, it is impoſſible for me to make any proportion or ſimilitude unto it. What then ſhall I do, but lay my ſelf down in mine own ſhadow, and there rejoyce that thou art a light ſo great, as I am not able to endure the dazzling ſplendor of thy rayes; that thy pleaſure is ſo exceſſive, as no part of it can enter into my circumſcribed heart, without dilating it ſo wide, that it muſt break in ſunder; and that thy happineſs is ſo infinite, as the higheſt pitch I can hope for to glut my ſelf withal, during this dark night of my tedious pilgrimage here on earth, is to ſee evidently, that it is impoſſible for me in this life, to frame any ſcantling of it; much leſs, to know how great it is? Shall I then once again preſume to break out into impatience, at my delay of ſo great bliſs, and cry out that I am content with the meaneſt ſhare of this exuberant felicity? I care not for the exaggerations which a longer life may heap up unto it. I am ſure here is ſufficient to ſwell my heart beyond it ſelf, to ſatisfie my thirſty ſoul, to diſſolve and melt all my powers, and to transform me totally into a ſelf-bleſſed creature. Away, away all tedious hopes, not onely of this life, but even of all increaſe in the next: I will leap boldly into that fountain of bliſs, and caſt my ſelf headlong into that ſea of felicity; where I can neither apprehend ſhallow waters, nor fear I ſhall be ſo little immerſed and drowned, as to meet with any ſhelf or dry ground, to moderate and ſtint my happineſs. A ſelf-activity, and unbounded extent, and eſſence free from time and place, aſſure me ſufficiently, that I need deſire no more. Which way ſoever I look, I loſe my ſight, in ſeeing an infinity round about me: Length without points: Breadth without Lines: Depth without any ſurface. All content, all pleaſure, all reſtleſs reſt, all an unquietneſs and tranſport of delight, all an extaſie of fruition.

Happy forgetfulneſs, how deeply am I obliged to thee, for making room for this ſoul raviſhing contemplation, by removing this whiles all other images of things far from me? I would to God thou mighteſt endure, whiles I endure; that ſo I might be drowned

drowned in this preſent thought, and never wake again, but into the enjoying, and accompletion of my preſent enflamed deſires. But alas, that may not be. The eternal light whom my ſoul and I have choſen for Arbiter, to determine unto us what is moſt expedient for us, will not permit it. We muſt return; and that into fears and miſeries: For as a good life breedeth encreaſe of happineſs, ſo doth an evil one, heap up Iliads of woe. Firſt (my ſoul) before I venture, we ſhould be certain, that thy parting from this life, waft thee over to aſſured happineſs: For thou well knoweſt, that there are noxious actions, which deprave and infect the ſoul, whiles it is forging and moulding here its body, and tempering for its future being: and if thou ſhouldeſt ſally hence in ſuch a perverſe diſpoſition, unhappineſs ſhould betide thee inſtead of thy preſumed bliſs. I ſee ſome men ſo ravenous after thoſe pleaſures, which cannot be enjoyed out of the body, that if thoſe impotent deſires acompany their ſouls into eternity, I cannot doubt of their enduring an eternity of miſery: I cannot doubt of their being tormented with ſuch a dire extremity of unſatisfiable deſire, and violent grief, as were able to tear all this world into pieces, were it converted into one heart; and to rive in ſunder, any thing leſs than the neceſſity of contradiction. How high the bliſs of a wel-governed ſoul is above all power of quantity, ſo extreme muſt the ravenous inclemency, & vulture-like cruelty, be of ſuch an uncompaſſable deſire gnawing eternally upon the ſoul; for the ſame reaſon holdeth in both: and which way ſoever the gravitation and deſires of a ſeparated ſoul do carry it, it is hurried on with a like impetuoſity and unlimited activity. Let me then caſt an heedfull and wary eye, upon the actions of the generality of mankind, from whence I may gueſs at the weal or woe, of their future ſtate: and if I find that the greateſt number weigheth down in the ſcale of miſery, have I not reaſon to fear leſt my lot ſhould prove among theirs? For the greateſt part ſweepeth along with it every particular, that hath not ſome particular reaſon to exempt it from the general law. Inſtead then of a few that wiſely ſettle their hearts on legitimate deſires, what multitudes of wretched men do I ſee? ſome hungry after fleſh and blood; others gaping after the empty winde of honour & vanity; others breathing nothing but ambitious thoughts; others graſping all, and groveling upon heaps of melted earth? So that they put me all in a horror, and make me fear, leſt very few they

be, that are exempted from the dreadfull fate of this incomprehensible misery, to which I see, and grieve to see, the whole face of mankind desperately turned. May it not then be my sad chance, to be one of their unhappy number? Be content then, fond man, to live. Live yet, till thou hast first secured the passage which thou art but once to venture on. Be sure before thou throwest thy self into it, to put thy soul into the scales: balance all thy thoughts; examine all thy inclinations; put thy self to the test, try what drosse, what pure gold is in thy self: and what thou findest wanting, be sure to supply, before nature calleth thee to thy dreadfull account. It is soon done, if thou beest what thy nature dictateth thee to be. Follow but evident reason and knowledge, and thy wants are supplied, thy accounts are made up. The same ever-shining truth, which maketh thee see that two and two are four, will shew thee without any contradiction, how all these base allurements are vain & idle; and that there is no comparison between the highest of them, and the meanest of what thou mayest hope for, hast thou but strength to settle thy heart by the steerage of this most evident science; in this very moment, thou mayest be secure. But the hazard is great, in missing to examine thy self truly and throughly. And if thou miscarry there, thou art lost for ever. Apply therefore all thy care, all thy industry to that. Let that be thy continual study, and thy perpetuall entertainment. Think nothing else worth the knowing, nothing else worth the doing, but screwing up thy soul unto this height, but directing it by this level, by this rule. Then fear not, nor admit the least doubt of thy being happy, when thy time shall come; and that time shall have no more power over thee. In the mean season, spare no pains, forbear no diligence, employ all exactness, burn in summer, freeze in winter, watch by night, and labour by day, joyn moneths to moneths, entail years upon years. Think nothing sufficient to prevent so maine a hazard; and deeme nothing long or tedious in this life, to purchase so happy an eternity. The first discoverers of the Indies, cast themselves among swarms of man-eaters; they fought and strugled with unknown waies: so horrid ones, that oftentimes they perswade themselves they climbed up mountains of waters, and straight again were precipitated headlong down between the cloven sea, upon the foaming sand, from whence they could not hope for a resource: hunger was their food; snakes and serpents

ſerpents were their dainties; ſword and fire were their daily exerciſe: and all this, only to be maſters of a little gold, which after a ſhort poſſeſſion was to quit them for ever. Our ſearchers after the Northern paſſage, have cut their way through mountains of yce, more affrightful and horrible, than the *Symplegades*. They have impriſoned themſelves in half year nights; they have chained themſelves in perpetual ſtone-cleaving colds: ſome have bin found cloſely imbracing one another, to conſerve as long as they were able, a little fewel in their freezing hearts, at length petrified by the hardneſs of the unmercifulneſs of that unmerciful winter: others have been made the prey of unhumane men, more ſavage than the wildeſt beaſts: others have been never found nor heard of, ſo that ſurely they have proved the food of ugly monſters of that vaſt ycy ſea: and theſe have been able and underſtanding men. What motives, what hopes had theſe daring men? what gains could they promiſe themſelves, to countervail their deſperate attempts? They aimed not ſo much as at the purchaſe of any treaſure for themſelves, but meerly to ſecond the deſires of thoſe that ſet them on work; or to fill the mouths of others, from whence ſome few crumbs might fall to them. What is required at thy hands (my ſoul) like this? And yet the hazard thou art to avoid, and the wealth thou art to attain unto, incomparably overſetteth all that they could hope for. Live then and be glad of long and numerous years; that like ripe fruit, thou mayeſt drop ſecurely into that paſſage, which duly entered into, ſhall deliver thee into an eternity of bliſs, and of unperiſhable happineſs.

And yet (my ſoul) be thou not too ſore agaſt, with the apprehenſion of the dreadfull hazard thou art in. Let not a tormenting fear of the dangers, that ſurrounded thee, make thy whole life here bitter and uncomfortable to thee. Let the ſerious and due conſideration of them, arm thee with caution and wiſdome, to prevent miſcarriage by them. But to look upon them with horror and affrightedneſs, would freeze thy ſpirits, and benum thy actions, and peradventure engulf thee through puſillanimity in as great miſchiefs, as thou ſeekeſt to avoid. Tis true, the harm which would acrue from miſgoverning thy paſſage out of this life, is unſpeakable, is unimaginable. But why ſhouldeſt thou take ſo deep thoughts of the hazard thou runeſt therin, as though the difficulty of avoiding it were ſo extreme, as might amount to an impoſibility.

I allow, the thoughts that arm thee with wise caution to secure thy self, cannot be too deep nor too serious; but when thou hast providently stored thy self with such, call thy spirits manfully about thee: and to encourage thee to fight confidently, or rather to secure thee of victory, so thou wilt not forsake thy self, turn thine eyes round about thee, and consider how wise nature, that hath prescribed an end and period unto all her plants, hath furnished them all with due and orderly means to attain thereunto: and though particulars somtimes miscarry in their journey (since contingence is entailed to all created things) yet in the generality, and for the most part, they all arive unto the scope she leveleth them at. Why then should we imagine, that so judicious and far-looking an Architect, whom we see so accurate in his meaner works, should have framed this masterpiece of the world, to perish by the way, and never to attain unto that great end, for which he made it; even after he is prepared and armed with all advantagious circumstances agreeable to his nature? That artificer, we know, deserveth the stile of silly, who frameth such tools, as fail in their performance, when they are applied to the action for which they were intended. We see all sorts of trees for the most part bear their fruit in due season; which is the end they are assigned unto, and the last and highest emolument they are made to afford us. Few beasts we see there are, but contribute to our service what we look for at their hands. The swine affordeth good flesh, the sheep good wooll, the cow good milk, the sable warm and soft fur, the oxe bendeth his sturdy neck to the yoke, the spiritful horse dutifully beareth the souldier, and the sinewy mule and stronger camel convey weighty merchandise. Why then shall even the better sort of mankind, the chief, the top, the head, of all the works of nature, be apprehended to miscarry from his end in so vast a proportion, as that it should be deemed in a manner impossible, even for those few (for so they are in respect of the other numerous multitude of the worser sort) to attain unto that felicity which is natural unto them? Thou (my soul) art the form, and that supreme part of me, which giveth being both to me and to my body: who then can doubt, but that all the rest of me, is framed fitting and serviceable for thee? For what reason were there, that thou shouldest be implanted in a soyl, which cannot bear thy fruit? The form of a hog, I see, is engrafted in a body fit and appropriated for a swines operations:

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the form of a horſe, of a lion, of a wolf, all of them have their organs proportioned to the maſtering piece within them, their ſoul. And is it credible, that onely man, ſhould have his inferiour parts raiſed ſo highly in rebellion againſt his ſoul, the greateſt Miſtris (beyond proportion) among all forms, as that it ſhall be impoſſible for her to ſuppreſs their mutinies, though ſhe guide her ſelf never ſo exactly by the preſcripts of that rule, which is born with her? Can it be ſuſpected, that his form, which is infinitely mounted above the power of matter, ſhould through the very neceſſity and principles of its own nature, be more liable to contingency, than thoſe that are engulfed and drowned in it? ſince we know, that contingency, defectibility, and change, are the lame children of groſs and miſhapen matter.

Alas it is too true, that nature is in us unhappily wrefted from her orginal & due courſe. We find by ſad experience, that although her depravation be not ſo total, as to bind entirely the eye of Reaſon ſhe ſeeth by, yet it is ſo great, as to carry vehemently our affections quite croſs to what ſhe propoſeth us as beſt. Howſoever, let the incentives of fleſh and blood be never ſo violent, to tumble humane nature down the hill, yet if a contrary force, more efficacious than they with all their turbulent and miſty ſtreams, do impel it another way, it muſt needs obey that ſtronger power. Let us then examine whoſe motives, the ſouls, or the ſenſes, in their own nature, work moſt efficaciouſly in man. We are ſure, that what pleaſure he receiveth, he receiveth by means of his ſou'; even all corporeal pleaſure: for, be the working object never ſo agreeable and pleaſing unto him, he reapeth thence ſmall delight, if in the mean time, his ſouls attention be carried another way from it. Certainly then, thoſe things muſt affect the ſoul moſt powerfully, which are connatural unto her, and which ſhe ſeizeth upon and reliſheth immediately; rather than thoſe impure ones, which come ſophiſticated to her, through the muddy channels of the ſenſes. And accordingly, all experience teacheth us, that her pleaſures, when they are fully ſavoured, are much ſtronger than the pleaſures of our ſenſes. Obſerve but the different comportments of an ambitious, and of a ſenſual man, and you wil evidently perceive far ſtronger motions, and more vehement ſtrains in the former, who hath his deſires bent to the ſatisfaction of his mind, than in the other, who aimeth but at the pleaſures of his body. Let us

look

look upon the common face of mankind; and we ſhall ſee the moſt illuſtrious and noble part, taken with learning, with power, with honor; and the other part, which maketh ſenſe their idol, moveth in a lower and baſer orb under the others; and is in a ſervile degree to them. Since then humane nature is of it ſelf more inclined to the contentments of the active minde, than of the dul ſenſe; who can doubt but that the way of thoſe pure contentments, muſt be far ſweeter than the groſs and troubled ſtreams of ſenſual pleaſures? which if it be, certainly man in his own nature, is more apt to follow that: and when he chanceth to wander out of that ſmooth and eaſie road, his ſteps are painfull and wearifom ones: and if he do not preſently perceive them ſuch, it is, becauſe it fareth with him, as with thoſe that walk in their ſleep, and ſtray into rough and ſtony paſſages, or among thiſtles and briers; whiles peradventure ſome illuding dream bewitcheth their fanſie, and perſwadeth them they are in ſome pleaſant garden; till waking, (if at leaſt they wake before they fall into a deadly precipice) they finde their feet all gored, and their bodies all ſcratched and torn. If any ſenſual man ſhould doubt of this great truth, and find it hard to perſwade himſelf, that intellectual pleaſures (which to his depraved taſte, ſeem cold and flat ones) ſhould be more active and intenſe, than thoſe feculent ones, which ſo violently tranſport him; let him but exerciſe himſelf a while in thoſe entertainments which delight the mind, taking leave during that ſpace, of thoſe unruly ones, which agitate the body; and continue doing thus, till by long practice, he hath made them eaſie, and habitated himſelf unto them: and I will engage my word, that he will finde this change ſo advantagious to him, even in contentment and delight, that he will not eaſily be brought back to his former courſe of life. Experience ſheweth us, that whatſoever is long cuſtomary to us, turneth into our nature; ſo much, that even diſeaſes and poyſons by diuturn uſe, do mould and temper to themſelves thoſe bodies, which are habituated to them; in ſuch ſort, that theſe peſts of nature muſt be kept on foot, and fed upon for our ſubſtance. How much more then muſt the moſt connatural exerciſe of natural pleaſure, turn ſo ſubſtantially in our being, that after ſome good practice in it, we ſhall not be able, without great ſtrugling and reluctation, to live without it.

The violence of fruition in thoſe foul puddles of fleſh and blood, preſently

preſently glutteth with ſatiety, and is attended with annoy and with diſlike: & the often uſing and repeating it, weareth away that edge of pleaſure, which onely maketh it ſweet and valuable, even to them that ſet their hearts upon it; and nothing heighteneth it, but an irritation by a convenient hunger and abſtinence. Contrariwiſe, in the ſoul, the great and more violent the pleaſure is, the more intenſe and vehement the fruition is; and the oftner it is repeated, ſo much the greater appetite and deſire we have to return unto the ſame; and nothing provoketh us more, than the entire and abſolute fruition of it. If a ſuddain change from one extream of fleſh and blood, to the other oppoſite pole of ſpiritual delights and entertainments, ſeem harſh to him, whoſe thoughts by long aſſuefaction are glewed to corporal objects; let him begin with gently bridling in his inferiour motions under a fair rule of government: If he cannot preſently ſuppreſſe and totally mortifie their clamorous deſires, let him at the leaſt moderate and ſteer them according to the bent of reaſon. If we will but follow this courſe which nature teacheth us, to heighten even our ſenſual delights and pleaſures, by reaſonable moderation of them to their own advantage; we ſhall finde her ſo kinde a mother to us, that of her ſelf ſhe will at length quel and diſincumber us of all our enemies. If we but temperately attend her work, ſhe will quietly waft us over to our deſired end, to our beloved happineſſe. In a few years, by boiling away our unruly heat, ſhe will abate, and in the end quite wear away the ſenſe of thoſe tranſporting pleaſures we uſed to take ſo much delight in the fruition of. With in a while, rheumes will ſo clog our tongue and palates, that we ſhall but flatly reliſh the moſt poinant meats. Our dull'd ears will no longer devour with delight, the raviſhing ſound of ſweet harmonies. Our dim eyes will carry to our heavy fanſie but confuſed news of any beautiful and pleaſing objects. Our ſtopped noſtrils will afford no paſſage for ſpiritful perfumes, to warm and recreate our moiſt and drowſie brain. In a word, nature will ere long warn us to take a long farewel of all thoſe contentments and delights, which require a ſtrong, vigorous, and athletick habit of body to enjoy. She will ſhew us, by ſetting our graves before our eyes, how vain this glittering fanſie of honor is: how unprofitable the ſtaffe of power to underprop our falling being; how more burthenſome than helpful are thoſe maſſie heaps of gold and ſil-

ver, which when we have, the greateſt uſe we make of them, is but to look upon them, and court them with our daz:led eyes; whiles they encompaſſe us with armies of traytors and of hungry wolves, to tear them from us, and us in pieces for their ſake. Thus will nature of her ſelf in a ſhort time, dull thoſe weapons that offend us, and deſtroy the enemies of thoſe verities that ſhine upon us. Courage then, my ſoul, and neither fear to live, nor yet deſire to die. If thou continueſt in thy body, it is eaſie for thee, and ſweet and contentſome to heap up treaſures for eternity. And if thou parteſt from it, thy hopes are great and fair, that the journey thou art going, is to a world of unknown felicity. Take heart then, and march on then with a ſecure diligence, and expect the hand of bounteous nature, to diſpoſe of thee, according as ſhe hath wiſely and benignly provided for thee. And fear not, but that if thou haſt kept a reaſonable amity with her, ſhe will paſſe thee to where thou ſhalt never more be in danger of jarring with her; nor of feeling within thy ſelf the unkind blows of contrary powers fighting in thee, whiles thou bleedeſt with the wounds that each ſide giveth; nor of changing thy once-gained happineſs into a contrary condition, according to the viciſſitudes of all human affairs: But ſhalt *For ever*, be ſwelled to the utmoſt extent of thy infinite nature, with this torrent, with this abyſs of joy, pleaſure, and delight.

But here (my ſoul) well mayeſt thou ſtand amazed at this great word *For ever*. What will this be, when fleeting time ſhall be converted into permanent eternity? ſharpen thy ſight to look into this vaſt profundity. Suppoſe that half an hour, were reſumed into one inſtant or indiviſible of time: what a ſtrange kinde of durance would that be? I ſee that half an hour, is diviſible without end, into halfs, and halfs of halfs, and quarters of quarters; and after myriads of diviſions, no parcel is ſo little, but that it hath an infinite ſuperproportion to an indiviſible inſtant. What a prodigious thing then muſt it be, to have an inſtant equaliſe half an hour? were it but ſome ordinary notion or quiddity, as of magnitude, of place, of activity, or the like, in which this excellency of an indiviſibles equaliſing a large extent, were conſidered; my fantaſie would offer to wreſtle with it; and peradventure, by ſtrong abſtraction, & by deep retirement into the cloſet of judgment, I might hazard to frame ſome likeneſs of it. But that wherein this multiplication

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it, is the nobleſt, the higheſt, and the root of all other notions, it is *Being* and *Exiſtence* it ſelf. I my ſelf, whiles I am, have my exiſtence determined but to one poor inſtant of time; and beyond that, I am aſſured of nothing. My ſlender thred of *Being* may break, I ſtill finde that it may break aſunder, as neer to that inſtant, as I can ſuppoſe any thing to be neer unto it: and when I ſhall have ſuppoſed, *Here* it may break neerer and neerer; and that I can never arrive to ſettle the neereſt point where it may ſnap in two. But when time ſhall be no more, or at the leaſt, ſhall in reſpect of me, be turned into Eternity; then this frail Exiſtence of mine, will be ſtretched out beyond the extent of all-conquering time. What ſtrange thing then, is this admirable multiplication of exiſtence? or how may I be able to comprehend it? Exiſtence is that which comprehendeth all things: and if God be not comprehended in it, thereby it is, that he is incomprehenſible of us: and he is not comprehended in it, becauſe himſelf is it. He is Exiſtence; and by being ſo, he equalleth, not comprehendeth it. From hence then I may gather the excellency and vaſt empire of exiſtence, in its own nature: and ſo conclude how admirable a change and betterment that muſt be, which encreaſeth, and multiplieth ſo infinitly the exiſtence I now enjoy; for be it never ſo ſpecious; be it never ſo glorious; be it what it is, exiſtence, the top, the flower, the perfection of all created things; ſtill there is a flaw, there is a defect, a ſhortneſs, a limitation in it: for now, my ſoul, thou art but a part of me; and doſt exiſt in ſuch a manner by ſucceſſion, that the ſecurity and poſſeſſion of it, is of leſs than of any thing whatſoever in the world; for it is of nothing more, than of an indiviſible; which being ſuch, in truth is nothing. But when the walls ſhall be broken down, that here confine thee to ſuch a nothing of exiſtence, (which yet is infinitely more noble, than all other degrees of notions) then thou ſhalt ſum up time in formal *being*, and not be limited, as now thou art, to this ſo divided a ſucceſſion. Thou ſhalt be an hour without diviſibility: and if an hour, a year: if ſo, an age: and if an age, then for ever, for all Eternity.

But whither art thou flown, my ſoul? to what a dazeling height art thou mounted? Thou art now ſoared to ſuch a leſſening pitch, as my faint eyes are no longer able to follow thy touring flight: my head groweth giddy, with gazing up; whiles thou looketſt down, to ſee time run an infinite diſtance beneath thee;

wasting the existences of all corporal things from nothing to nothing, in a perpetual stream: and thou secure, and out of the reach of its venimous and all-destroying truth. Let me call to mind, all the violent pleasures of my heady youth: let me sum up their extent according to those deceitful measures I then rated happiness by: let me in my fansie chew over again the excessive good I then fondly imagined in them: and to all this, let me add as much more joy and felicity, as in my weak thoughts, I am able to fadom or but aim at: and then let me say (and with rigorous truth I shall say it) all this excess of bliss, will be resumed, will be enjoyed to the full, in one indivisible moment: let me think with my self, if then, when pleasure was the Idol I sacrificed all my thoughts unto, I might in one quarter of an hour have enjoyed a pleasure, or at the least, have hoped for one, that should have equalised at once all those, that in my life I ever tasted: what would not I have been content to give in purchase of that single quarter of an hour? and instead of this pleasant dream, I now see that one real moment, will truly and solidly give to thee and me, the quintessence, the elixir of content and happiness; not drawn out of such 40 years, as I have struggled through the world in various fortunes; but out of ages and ages of pleasure, greater far than can be conceived by a heart of flesh; and multiplied beyond the Arithmetick of intelligences. And this happy moment, shall not be of their suddain fleeting and expiring nature, that are assigned to time; but shall endure beyond the extent of that time, which surpasseth all multiplication. I see plainly that I must multiply eternity, by eternity, to frame a scantling of that bliss, which a well-passed life in this world, shall bring me to in the next. And yet it will be as far short, and as much beneath the self-blessedness of him that giveth one this, as nothing is short of all that is. For my bliss shall have a beginning; and though it never shall have end, yet that belongeth not to it for its own sake, but proceedeth meerly from the bounteous hand of the nothing annihilating self essence: from whom there is no more fear of the failing of his liberal superfluence of *Being* upon me, than there is of his own deficiency from being self *Being*. But how can these things stand together? That indivisibly I shall possesse a tenure beyond all possible time? and nevertheless *possibly*, notwithstanding my possession, I may be bereft of what I enjoy? who can read this riddle? who can dive

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into this abyss? who can shoot light into this infinite pit of darkness? It is the abundance and excess of light that here striketh us blinde. Who can strengthen our eyes to endure eagle-wise this glorious and resplendent Sun? Nothing sure in this world; unless it be silence and solitude. To these therefore let us consecrate the reverend contemplation of this awfull mystery; which is but profaned, if it be exposed to vulgar eyes: and to such night-owles and battes as we are, whiles the troubled fanfies of reeking sense and worldly occupations do overcloud my ary thoughts.

Now then if nature by short and thick steps at the beginning, and by larger paces in the progress, hath delivered us over into a night of pure light, where we can see nothing, because every thing is too visible; so that we are fain to veil our eyes, and are constrained to retire our selves to medicate and arm them, before we expose them to so strong and glorious beams: how should we dare to look upon those admirable heights (infinitely surpassing all these) with which the overconquering grace hath crowned and swelled up the extent of nature? What sight is sharp enough to penetrate into the mysterious essence, sprouting into different persons? Who can look upon the self-multiplyed unity, upon the incomprehensible circumincession, upon those wondrous processions, and idioms reserved for Angels eyes?

Of these, (my soul) whose shootings reach infinitely higher beyond all that we have said, than what we have said is beyond the dull and muddy motions of this life; thou art not capable now of receiving any instructions: let first the mystagogical illuminations of the great Areopagite; and the Ascetick disciplines of the Anachoretical inhabitants of the wilderness, purifie the eye, before thou attempt to speak, or to aim at the discovery of these abysming depths. By them thou must be first irrigated with the sweet showers of mornings and evenings, with the gentle dews and manna-drops, which fall abundantly from those bounteous favours that reside in a higher sphear than nature, and that pour out unknown and unconceivable blessings upon prepared hearts: which fructifie into that true bless, in comparison whereof, all that we have hitherto declared, is but shadow, vanity, and nothing.

FINIS.

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PRIVILEGE DU ROY.



OVYS PAR LA GRACE DE DIEU ROY DE FRANCE ET DE NAVARRE, A nos amez & feaux les gens tenans nos Cours de Parlemens, Baillifs, Seneſchaux, Prevoſts, leurs Lieutenans, & tous autres nos Juſticiers & Officiers qu'il appartiendra, Salut, *Le Sieur Kenelme Digby Chevalier Anglois, nous a fait remonſtrer qu'il a compoſé un Liure en langue Angloiſe, contenant deux Traitez, l'un de la nature du corps, & l'autre de la nature des ames, avec une recherche de l'immortalité de celles qui ſont raiſonnables.* Lequel il deſireroit mettre en lumiere & faire imprimer, s'il avoit nos lettres à ce neceſſaires: leſquel les nous faiſant ſupplier luy vouloir octroyer. A ces cauſes luy avons permis & accordé, permettons & accordons par ces preſentes faire imprimer & debiter ledit Liure pendant ſixans. Durant leſquels nous faiſons deffenſes à tous Libraires & Imprimeurs de noſtredit Royaume, de l'imprimer vendre, ny debiter, ſoit ſous quelque marque de déguiſement ou traduction que ce ſoit, ſans le conſentement dudit ſieur *Digby*, à peine de trois mille liures d'amende, confiſcation des exemplaires qui s'en trouveront, & de tous deſpens dommages & intereſts invers luy. Si vous mandons & à chacun de vous enjoignons tenir la main à l'execution des preſentes, leſquelles voulons eſtre tenuës pour devëment ſignifiées, en mettant copie d'icelles au commencement ou à la fin de chacun deſdits Liures. A la charge de mettre par ledit ſieur *Digby* une exemplaire dudit Liure en noſtre Biblioteque, & une autre en celle de nullité deſdites preſentes. Car tel eſt noſtre plaiſir nonobſtant oppoſitions ou appellations quelconques, clameur de *Haro*, chartre *Normande* & lettres à ce contraires. Donné à *Fontainebleau* le vingt-ſixieſme jour de *Septembre*, l'an de grace mil ſix cens quarantequatre, & de noſtre Regne le deuxieſme.

Par le Roy en ſon Conſeil.

GUITONNEAU.